WALKair™ 3000

System Manual

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Contents

WALKair™ 3000

System Description

About This Guide

This guide introduces and describes the WALKair 3000 system. It includes a description of the WALKair 3000 system architecture, system features and services, and network management. It also provides tabulated WALKair 3000 system specifications and a physical description of the outdoor and indoor hardware units and interfaces.

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Chapter 1 - Introduction

In This Chapter:

Overview

WALKair 3000 is an advanced point-to-multipoint (PMP) broadband wireless access solution, delivering Carrier Class services at upstream and downstream rates of up to 34Mbps. WALKair 3000 provides last mile solutions for small and medium businesses and multi-dwelling and multi-tenant unit (MDU/MTU) applications. In addition, WALKair 3000 provides the optimal solution for next generation cellular backhauling applications.

The following figure illustrates WALKair 3000 PMP architecture: a single BS communicating with a number of TSs.

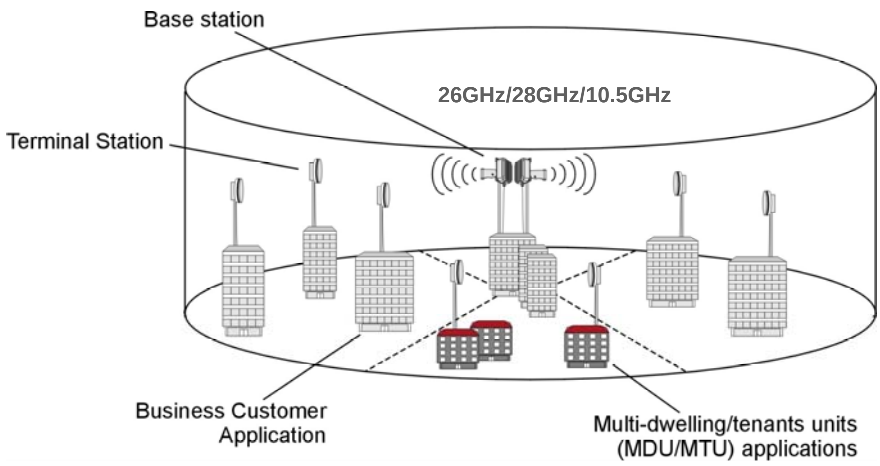


Figure 1-1. WALKair 3000 PMP Architecture

This new system operates in the Operating in the 10.5/26/28 GHz band. It is based on Alvarion's industry-leading cluster of high spectral efficiency, frequency reuse and dynamic bandwidth allocation technologies. The solution provides the highest coverage capacity available from any broadband wireless access vendor.

Innovative technology featuring fiber-optic quality voice and data services for high-speed IP data and Internet applications enables WALKair 3000 to meet the current and future services and capacity requirements of new operators and established carriers in Europe and other regulated markets. As a broadband wireless access solution, WALKair 3000 is ideally suited for developing countries where a lack of infrastructure poses an additional challenge.

The WALKair 3000 10.5 GHz and 26 GHz band models can be fully integrated and co-located with the WALKair 1000 system.

WALKair 3000 system components can be managed and monitored either locally, through RS232 connection to the BS equipment, or remotely, from the Network Operating Center (NOC) via the **WALKnet** management (standalone) application.

Features

WALKair 3000 delivers a comprehensive range of product features, ensuring fast, consistent and reliable data and voice services, including:

- **Single PMP infrastructure** used for broad wireless access and for cellular backhauling
- **Scalable**, stackable architecture to meet changing needs
- **IDU and ODU Redundancy**
- **Supported RF bands –** 10.5 GHz, 26 GHz and 28 GHz ETSI, and 26 GHz Chinese (MII)
- **Data rate and channels -**
    - For 14 MHz channels - up to 34 Mbps (upstream and downstream) per Terminal Station (10.5/26/28 GHz)
    - For 7 MHz channels - up to 16.384 Mbps (upstream and downstream) per Terminal Station (10.5/26/28 GHz)
    - For 3.5 MHz channels - up to 8.192 Mbps (upstream and downstream) per Terminal Station
- **Multi-carrier FDD and TDMA system**, up to four carriers per sector
- **Dual modulation**, 16QAM and QPSK with automatic switchover
- **Full end-to-end QoS** supporting IP QoS/CoS, QoS using I ETF standard in differential service (diffserv).
- **Flexible service provisioning** combining committed and maximum information rates (CIR/MIR) and support for different classes of SLAs
- **Customer Premise Equipment (CPE) services:** IP (10/100 Base-T), TDM and Leased Lines (8 x E1)
- Spectral efficiency - 2.5 bit/sec/hz
- **Management –** in-band and out-of-band (over Ethernet)
- **SNMP-based management system** and powerful network planning tool
- **Alvarix Solution –** provides full integration of WALKair 3000 and WALKair 1000 (10.5 GHz and 26 GHz models) systems

New Features in Version 4.0

- Some port parameters (i.e. duplex mode, E1 Loopback, etc.) and service parameters (i.e. CIR, MIR) can be modified (without deleting and recreating the relevant port or service)
- Narrow channel spacing bands:
    - 26/28 GHz: 7 MHz channel added to the existing 14 MHz channel
    - 10.5 GHz: 3.5 and 7 MHz channels added to the existing 14 MHz channel; 3.5 MHz channel requires installing the BS IDU and TS IDU devices that support this function
- Rx Operation Points can be customized for each TS in order to optimize the link performance
- Last error indication – default fault descriptions can be viewed through the WALKnet
- Indication of available (free) bandwidth for IP and TDM services in the WALKnet BS-SA View
- Sector fault status are propagated to the WALKnet map view in colors (Green, Orange, Red) corresponding to the highest fault for that sector
- Auto-save of configuration – *changes* in configuration are automatically saved every 15 minutes
- Auto-backup – configuration file is automatically backed up to TFTP at user defined intervals of 24, 48 or 72 hours.
- Redundancy – point-to-multipoint IDU and ODU redundancy.

NOTE: Redundancy requires additional equipment for implementation: for IDU redundancy - an E1 switch and a second BS-SA; for ODU redundancy - IF-MUX 4 and a second RFU

- IF-MUX 4 – used to implement ODU redundancy, as well as for integrating up to four IDUs for configurations of up to four carriers. The IDUs can be any combination of BS-SA 3000 and BS-BU 1000 units
- E1 Switch – used to implement IDU redundancy (E1 and LCI management port)
- Simultaneous SW download of all TS – TS software is broadcast from the host BS-SA
- In-band management – BS-SA management can also be implemented via the data Port

WALKair 3000 Cellular Architecture

WALKair 3000 *cell based* architecture provides a coverage area of three to five miles per cell, the coverage area depending on subscriber density and topographical conditions. Each cell consists of one BS at the cell center and a number of TSs within the BS coverage area.

The coverage area is increased by deploying multiple WALKair cells adjacent to each other, as illustrated by the following figure.

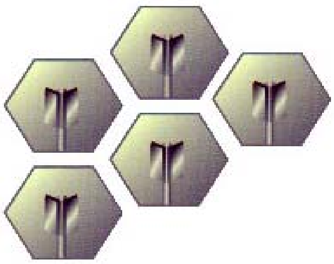
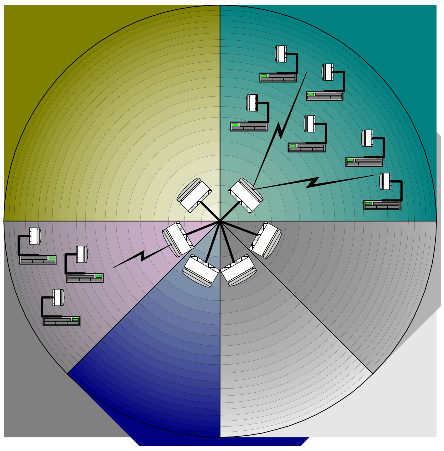


Figure 1-2. Illustration of Multi-cell Area Coverage

The BS, located at the center of the cell, provides traffic to a number of TSs located within the cell. The coverage area of each cell can be divided into segments or *sectors*.

WALKair 3000 supports configurations of up to 1/2/4/6/8 sectors per cell. The supported configurations depend on the frequency range: for example, in the 10.5 GHz range, 90° and 60° sectors are supported, while in the 26/28 GHz range, 180°, 90° and 45° sectors are supported. The sectors do not necessarily have to be evenly distributed. The following figure illustrates a six-sector configuration, in which four of the sectors are 45° each (lower half) and two of the sectors are 90° each.



WALKair 3000 Network Architecture

The WALKair 3000 System can be incorporated at the access point of both data and voice networks. On the Base Station side, the system interfaces with the backbone/transport network using E1 Interfaces, or with IP/Layer 2-based backbones using 10/100BaseT Ethernet interfaces.

On the Terminal Station side, the system provides a variety of data and voice interfaces for 10/100BaseT Ethernet, E1 and Leased Lines.

This section illustrates various topologies.

IP Networking

ETH – ETH service supports IP traffic flows between the BS and TSs. At the BS-SA (Base Station), the traffic is received at the 10/100 BaseT ETH port.

In this type of configuration, a router should be installed before the Base Station.

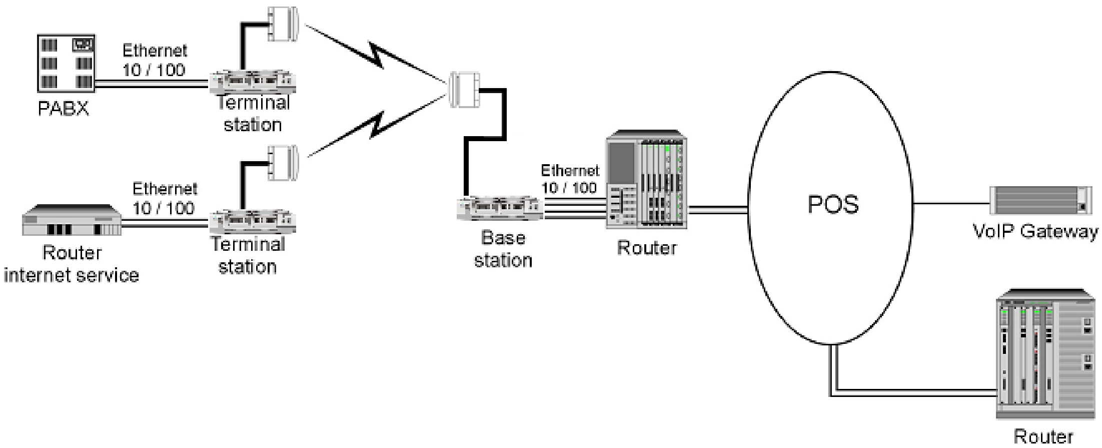


Figure 1-3. VoIP and Data Services

SDH/PDH Networking

E1 – E1 service supports TDM connections between the BS and TSs. The services can be configured as full E1 services or fractional E1 services.

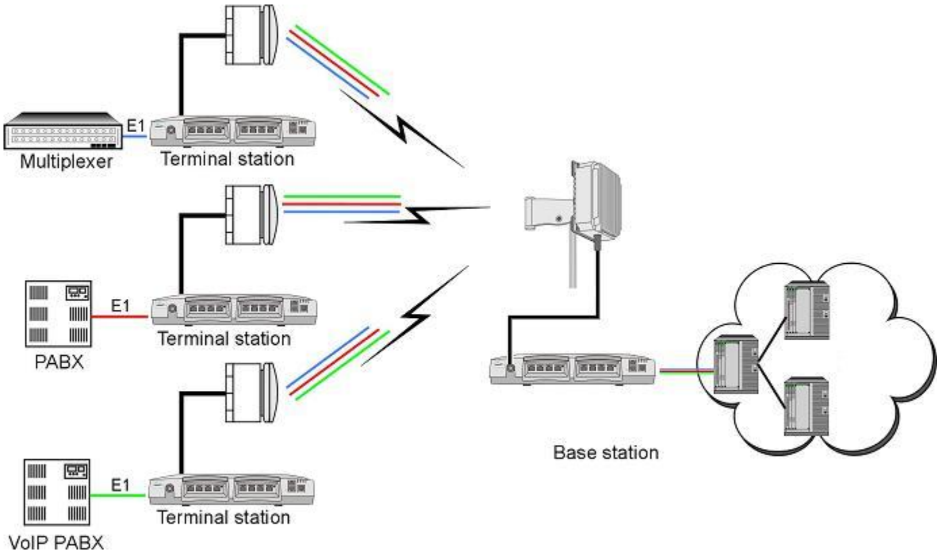


Figure 1-4: SDH Networks Leased Line Services

IP/UMTS Backhauling

The UMTS mobile network is based on standardized data communication protocols such IP. WALKair 3000 provides a flexible, highly efficient and robust data-oriented method for UMTS operators to connect their base station traffic to the backbone.

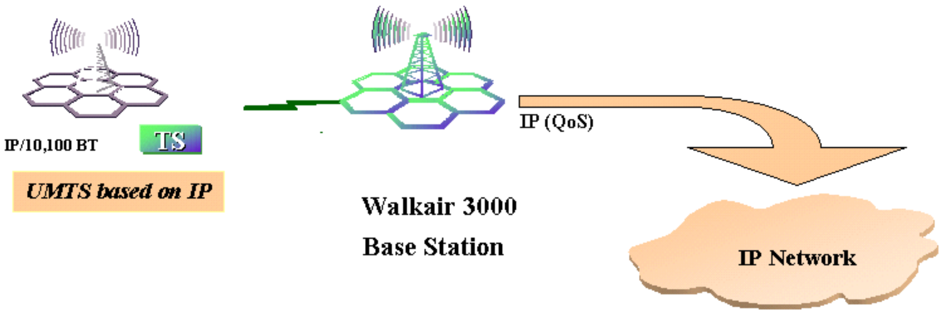


Figure 1-5: Next Generation Cellular (UMTS) Backhauling by IP

Access Method

At least one **Outdoor Unit** (ODU) is allocated per sector at the Base Station (BS) site. Each WALKair 3000 Base Station ODU comprises a Multi-Carrier system, which is capable of transmitting and receiving up to four Carriers (using IF-MUX 4) with different center frequencies.

The WALKair 3000 access method leverages **TDMA** (Time Division Multiple Access) technology. Each Carrier can support traffic from up to 64 TSs, where each TS is allocated a transmission time (Burst) in which it communicates with the BS. The BS controls the timing and length of each TS Burst, according to traffic load on this TS. Each TS can handle both TDM and IP traffic.

End-to-End QoS

WALKair 3000 supports up to 16 IP SLA/Data Service Pipes per TS. Prioritization is implemented according to the customer's SLA definitions consisting of:

- CIR
- MIR
- Up to 4 CoS levels - 1 to 4 prioritized queues. Platinum, Gold, Silver and Bronze client types

Classification and prioritization are performed according to IETF's DiffServ standard which utilizes the Type Of Service (ToS) bits in the IP header in order to differentiate various CoS traffic types. Strict Priority Queuing ensures an efficient and optimized traffic handling according to the assigned priority.

Dynamic Bandwidth Allocation (DBA) provides BW based on actual demand traffic rate and SLA per TS and customer. This ensures fair share to all customers based on their service attributes and their SLA. Unused MIR and CIR BW is shared among active customers.

Cell switching based air protocol uses fixed size air cells and ensures a constant delay for high priority data.

WALKair Applications

WALKair 3000 stackable system was designed to meet the current and future services and capacity requirements of new operators in Europe and other regulated markets.

Business Customers

Business customers are typically located in independent customer sites over an urban/suburban area. The covered area may be large - several hundred square kilometers, or small - a few square kilometers. The average capacity requirement per customer may vary significantly from one area to another and the number of customer sites and the average capacity per customer are expected to grow significantly within a few years.

WALKair 3000 is designed to suit WLL applications for business customers. The system directly connects locations of **Small Enterprises (SE)** and **Medium Enterprises (ME)** and **Multi-dwelling Units (MDU),** providing high quality voice and data services.

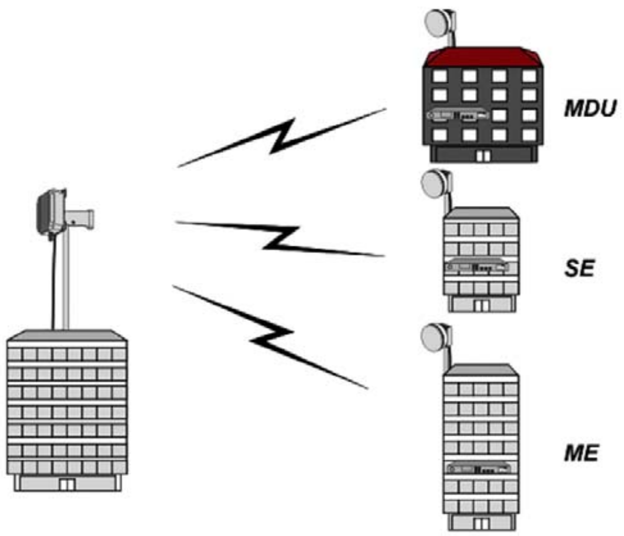


Figure 1-6: Typical SME/MDU Applications

SE/ME Business Customers

In SE/ME business applications, the WALKair 3000 Terminal Station is located at the Business premises. It is connected to the customer CPE equipment and provides the following services:

- Typical peak rate of up to 4 Mbps for small-enterprises and 25 Mbps for medium-enterprises

- Point-to-multipoint (PMP) delivery at upstream and downstream rates of up to 34 Mbps (for 14 MHz channels). Prioritization according to the customer's SLAs - committed and maximum information rates (CIR/MIR)
- Always On services
- SLA and service statistics
- High Speed Internet / Intranet / VPN / LAN Interconnect Access
- IP/Layer 2 oriented applications: VoIP, Video Conference (IP Multicast), Remote Learning, E-Commerce, Mail Service, WEB Hosting
- Application Service Provider (ASP)
- Legacy Telephony (2-30 POTS)
- Security and Addressing: Access List Control, NAT, DHCP, VPN
- Service Integration: Network Management, System administration

Multi-Dwelling Units

In Multi-Dwelling applications, the WALKair 3000 TS is located in the residential/office buildings (either near the roof or in the cellar). Service from the TS to residents or offices located at the same building is provided through the TS connection to multiplexers, switches or routers.

Data applications can be served via the WALKair 3000 TS Ethernet port by connecting to a low cost Ethernet switch which also provides security for MDU customers.

A VLAN (Virtual LAN) is defined per each office/resident. Data packets of each VLAN are uniquely identified using a VLAN ID as defined by 802.1Q standard. Each VLAN is a close and secured group, which is protected and distinguished from the other VLANs. Broadcast messages always remain within the VLAN boundaries and cannot be seen by other members on the switch.

Thus, customer traffic is secured by the switch within VLAN (Virtual LAN) and prioritized by WALKair 3000 TS according to Diff-Serv standard in order to maintain QoS for VoIP applications. It is then mapped to IP tunnel and carried towards the network using actual VPN, maintaining a secured environment over the air to each customer (office).

The MDU application assumes 4-8 business subscribers per building:

- Typical peak rate: Per business up to 2Mbps and aggregated up to 4Mbps-8Mbps
- Always On services
- SLA and service statistics
- High Speed Internet / Intranet / VPN / LAN Interconnect Access

- IP oriented applications: VoIP, Video Conference, Remote Learning, E-Commerce, Mail Service, WEB Hosting, Entertainment / Multimedia (IP Multicast)
- Application Service Provider (ASP)
- Legacy Telephony: Per business 2-4 POTS(0.1 Erlang) and aggregated 12-30 Lines (1-3Erlang)
- Service Integration: Network Management, System administration
- Security and Addressing: Access List Control, NAT, DHCP, VLAN, VPN

Next Generation Cellular (UMTS) Backhauling

As the next generation of cellular (UMTS-Universal Mobile Telecommunication System) mobile networks is being deployed, it is evident that a sophisticated and efficient backbone system is required. WALKair 3000 supports UMTS mobile network based on IP data communication protocols.

NOTE: Support for ATM can be provided using external devices).

WALKair 3000 enables UMTS operators to connect their base station traffic (Node-b) to the backbone using a flexible, highly efficient and robust data-oriented system.

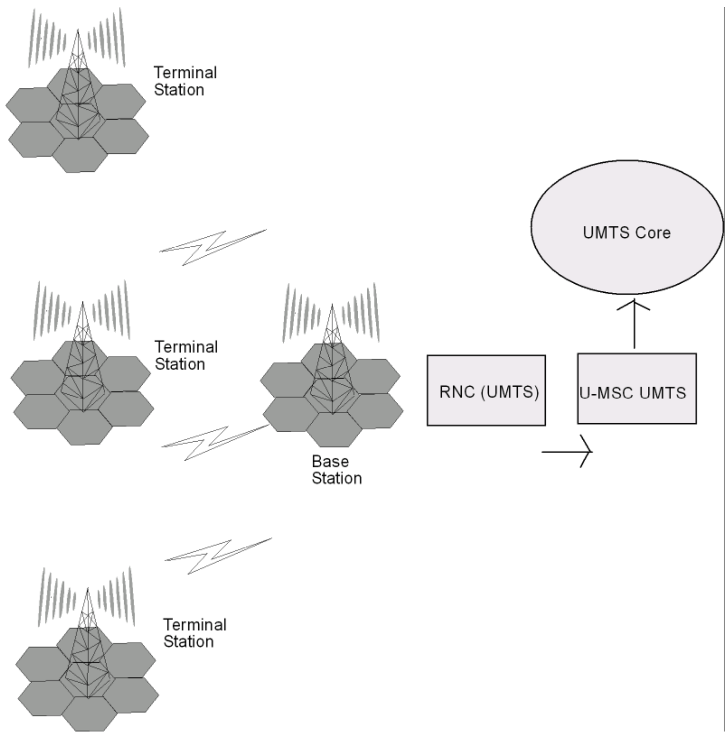


Figure 1-7: Next Generation Cellular (UMTS) Base Station PMP Feeding

The WALKair 3000 Base Station supports IP/Layer 2 networks by using 10/100BaseT Ethernet interfaces. The WALKair3000 system is ideally suited for IP based UMTS networks.

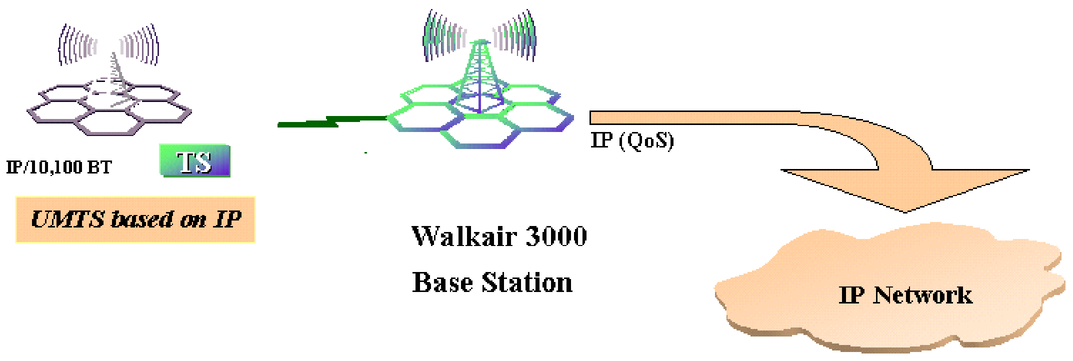


Figure 1-8: IP Next Generation Cellular (UMTS) Backhauling

Today the WALKair products are implemented in several mobile networks around the world as backhauling solutions. With some networks extending to hundreds of BTSss connected, mobile operators leverage the advantages of this efficient and secured PMP backbone system.

2

Chapter 2 - System Description

In This Chapter:

Overview of System Architecture

The WALKair 3000 PMP system consists of a **Base Station (BS)** to which *multiple* **Terminal Stations (TS)** are connected via radio channels.

On the downlink (from BS to TSs), the digital bitstream containing voice, data and video information is converted at the BS into microwaves that are transmitted to a small antenna at the customer's premises. The microwaves are then reconverted back into a digital bitstream at the TSs and delivered to the end-user. The process is reversed for upstream traffic. The base station receives the microwave signal, converts it into a digital bitstream and routes it through, or 'backhauls' to, the wider network, through which the data or call is delivered to its destination.

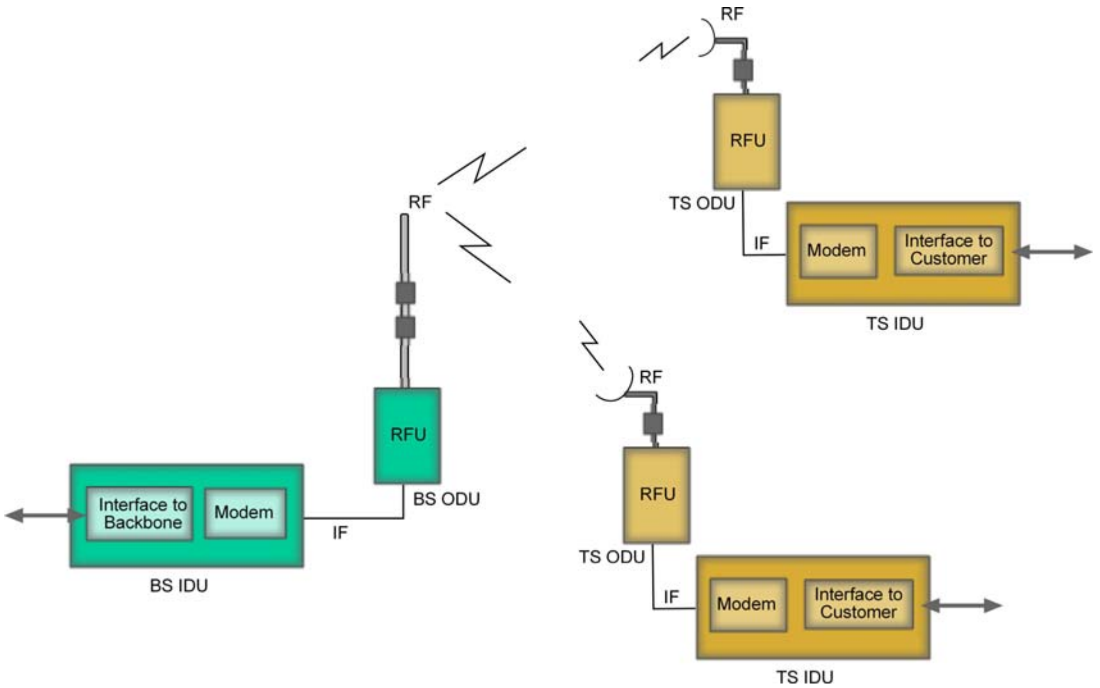


Figure 2-1. System Architecture

The high frequencies (10.5 GHz and above) in which WALKair 3000 operates, require line-of-sight between the base station and customer premise transceivers, hence WALKair 3000 TS and BS RF equipment consisting of the antennas and converters is installed outdoors in a high location (usually on a rooftop). This equipment is referred to **ODU** (TS-ODU and BS-ODU).

The digital interface and control equipment is located indoors in a temperature controlled environment. This equipment is referred to **IDU** (TS-IDU and BS-IDU).

The ODU and IDUs at each site are interconnected via an IF interface cable. The base station is connected to the wide-area network. At the customer's premises, the signal is delivered to the end-user terminals via Ethernet or E1 interfaces.

System Equipment

On the BS side, the **BS-SA** stackable IDU provides E1 and Ethernet connections to the backbone. On the TS side, the **TS-BU** IDU connects to the service areas. The Base Station ODU (RF unit and antenna) communicates with the terminal stations over-the-air through the Terminal Stations ODU (RFU and antenna). The ODUs and IDUs, on the both BS and TS sides, are interconnected through IF cables.

Each Terminal Station provides various Data and Telecom services, such as 10/100 BaseT, E1 and leased lines, using a flexible bandwidth of up to 34 Mbps (depending on the channel width). The Base Station network capacity per sector, 136 Mbps, is allocated as required among the TSs using dynamic bandwidth allocation.

The BS-SA and the corresponding TS-BUs are managed through connection to the BS-SA. The connection may be through a local connection to the Local Craft Interface **(LCI)** port, or remotely from the **Network Operating Center (NOC)** - through the **WALKnet** management application (separate application).

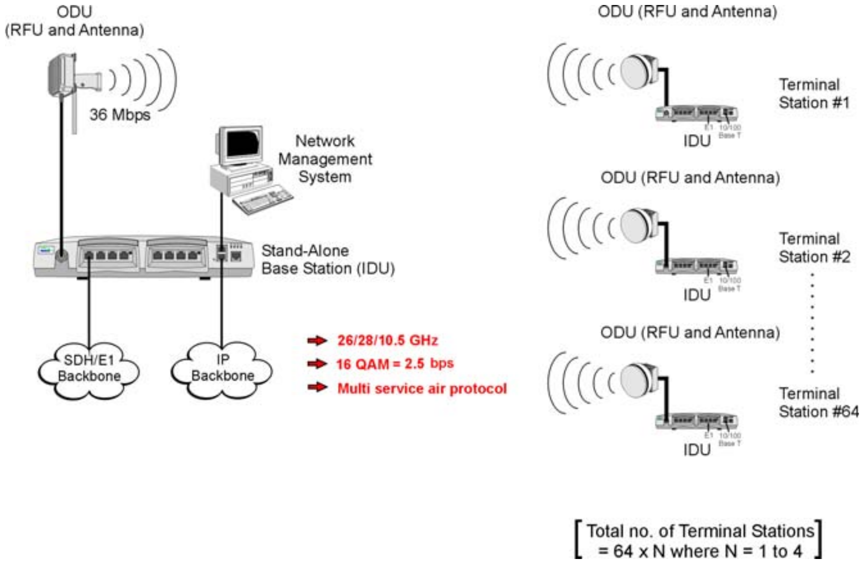


Figure 2-2: WALKair 3000 System

NOTE: For 14 MHz channel, QPSK of 1.2 bps is available.

Base Station Equipment

The Base Station (BS) equipment consists of indoor (IDU) and outdoor (ODU) equipment that are interconnected through an **IF** cable.

NOTE: The number and type of elements in the indoor and outdoor equipment varies depending on the site topology.

BS Indoor Units

The following elements may be part of a **BS IDU**:

- **BS-SA** – provides interface to the backbone and to the RF equipment
- **IF-MUX 2** – used to implement *two carriers* per sector configuration
- **IF-MUX 4** – used to implement configurations of up to *four carriers* per sector (including Alvarix topology) and ODU redundancy.
- **E1-Switch** – used to implement IDU redundancy

BS-SA Description

The BS-SA is a stackable, 1U high unit that can be installed in rack, mounted on a wall, or simply placed on a flat surface such as a desk. It provides the following functions:

- Connection to 10/100BaseT IP/Layer 2 backbone
- Interface to E1 SDH backbone
- Base-band to IF signal conversion
- Local and remote management capabilities of the BS-SA and the TSs which it hosts.

Power is provided by a dedicated -48 VDC power source.

Several BS-SA models corresponding to the various frequency bands are available: **10.5 GHz**, **26 GHz** and **28 GHz**.

The following figure shows the BS-SA unit.

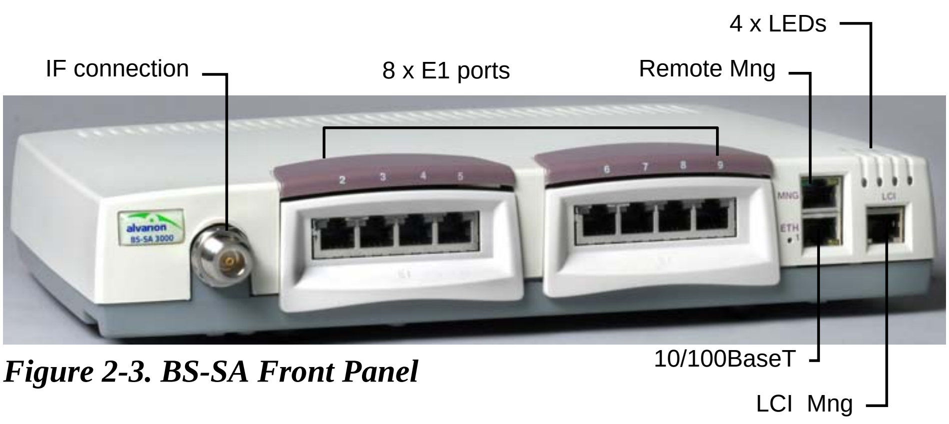


Figure 2-3. BS-SA Front Panel

IF-MUX II

IF-MUX II is used to implement dual carrier per sector configurations by multiplexing the IF signals from *two* BS-SA units and feeding them to one RF (outdoor) device.

IF MUX multiplexes the Tx signals from the BS-SAs and combines the output signal with a 48V DC signal. The IF and power signals are fed to the RFU via a coaxial cable. In the reverse direction, the IF signal from the RFU is de-multiplexed and fed to both BS-SAs.

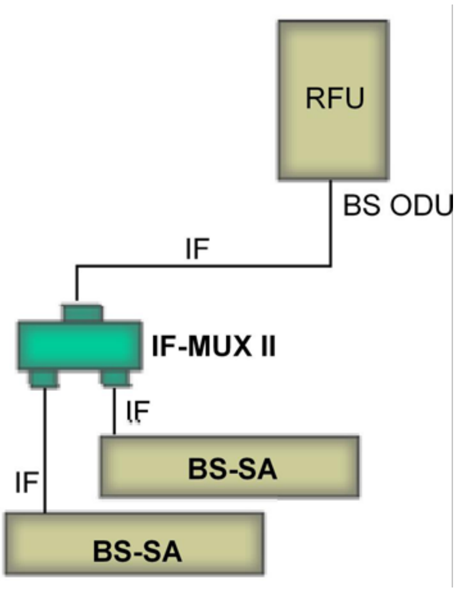


Figure 2-4. IF-MUX II configuration

IF-MUX 4

NOTE: IF-MUX 4 is relevant to all frequency bands from 3.5 GHz (for Alvarix) to 28 GHz.

IF-MUX 4 is used to:

- Implement configurations of up to four carriers per sector;
- Implement ODU redundancy;

The IF-MUX 4 front panel contains the IF connections to the BS-SA (3000) and BS-BU (1000).

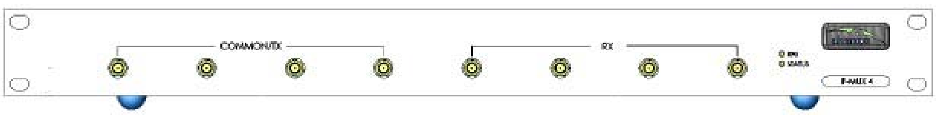


Figure 2-5: IF-MUX 4 Front Panel

The IF MUX multiplexes the Tx signals from up to four BS-BUs and BS-SA devices and combines the output signal with a 48V DC power supply. The IF signal is sent to the RFU, located near the Antenna, via a coaxial cable. The reverse process applies for Rx signals.

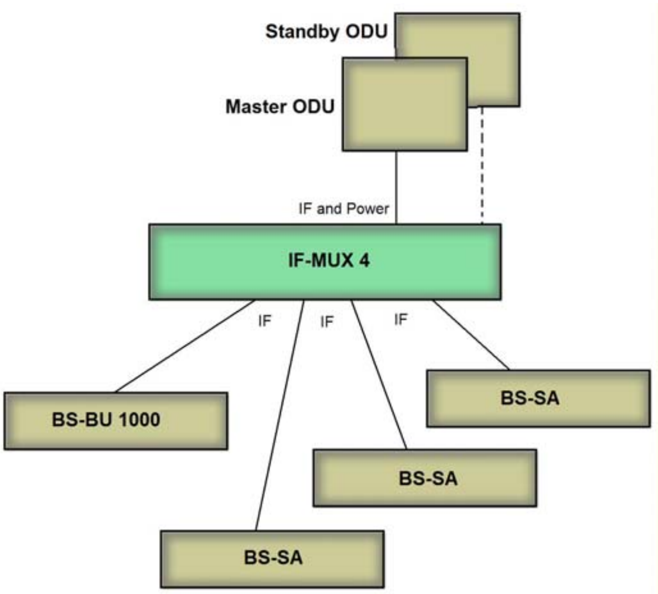


Figure 2-6. Example of IF-MUX 4 Configuration

The rear-panel contains the RF connection ports, RF redundancy control ports, the power connection and fuse locations.

NOTE: All fuses are (TBD)

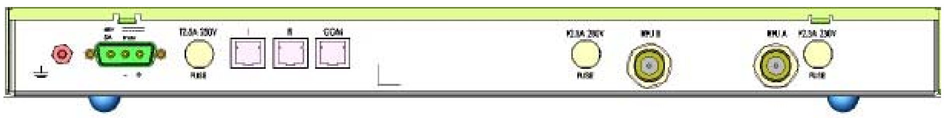


Figure 2-7: IF-MUX 4 Rear Panel

E1 Switch

The E1 Switch is used to implement BS-SA redundancy functions. These include:

- Switching up to 16 E1 lines from one BS-SA to another.
- Monitoring the communication channel between the BU-SA and IF-MUX 4

The E1 switch front panel contains all the connections to the backbone and to the BS-SA units. The rear panel contains the power connection only.

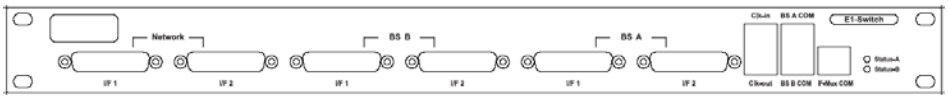


Figure 2-8: E1 Switch Front Panel

For complete information on the E1 switch:

This section contains a brief description of the E1 switch. More information is provided in the relevant sections as follows:

- Use of E1 switch in IDU redundancy configurations – *System Description - Chapter 3 - IDU Redundancy, page 3-13.*
- E1 Specifications – *System Description Chapter 5 - Specifications, E1 Switch Specifications, page 5-13.*
- E1 Switch Operation and Connections – *Installation Manual – Chapter 6 – Base Station IDU, E1 Switch*
- E1 Switch Pinout - *Installation Manual – Appendix B - Pinouts, E1 Switch Pinout*

BS-ODU Description

The **BS ODU** equipment consists of:

- **Antennas –** provides sector coverage by transmitting/receiving the signals to/from the corresponding TSs
- **RF** devices - perform the IF/RF frequency conversion between the antennas and the IDU for the corresponding sector.
- **De-MUX –** used to implement two-sector per carrier configurations. ***This is a weather proof unit installed outdoors.***

Each BS ODU consists of one antenna one RF unit *per sector*. For example, if there are four sectors, then four ODUs are installed. The antenna provides the coverage for the sector, while the RFU performs the up- down-conversion of the IF/RF signal and amplification/attenuation of the signal.

The RF unit is connected to the BS-SA either directly or through a multiplexer – depending on the number of carriers in the site and the number of sectors per carrier.

NOTE: WA3000 system supports up to four carriers (BS-SAs, BS-BUs) per sector and up to two sectors (RFUs) per carrier.

The model of BS ODU that is supplied depends on the frequency band in which the system will operate. The **example** shown below is the RFU for the 26 GHz band system.

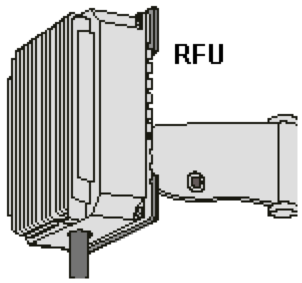


Figure 2-9: 26 GHz Base Station RFU and Horn Antenna

NOTE: For 10.5 GHz and 26 GHz systems, the WALKair 3000 BS and TS ODU components are identical to that of the WALKair 1000 BS and TS ODU components, thereby facilitating combined deployment and migration.

TS Equipment

The **TS IDU** equipment consists of a **TS-BU** units. The **BS ODU** consists of an **antenna** which transmits/receives the signals to/from the BS and the **RF** equipment that performs the IF/RF frequency conversion.

The ODU and IDU are interconnected through an **IF** cable.

Antennas are chosen based on the desired coverage of potential subscribers, taking into consideration the terrain, interfering objects, antenna azimuth pattern, antenna elevation pattern, and antenna gain.

TS-BU

The Terminal Station Indoor Unit (IDU) is located at the customer premises in a temperature-controlled environment.

The TS-BU performs the following functions:

- Provides Ethernet interface
- Provides E1 port interfaces

- Implements the signal base band to IF conversion and provides the IF interface

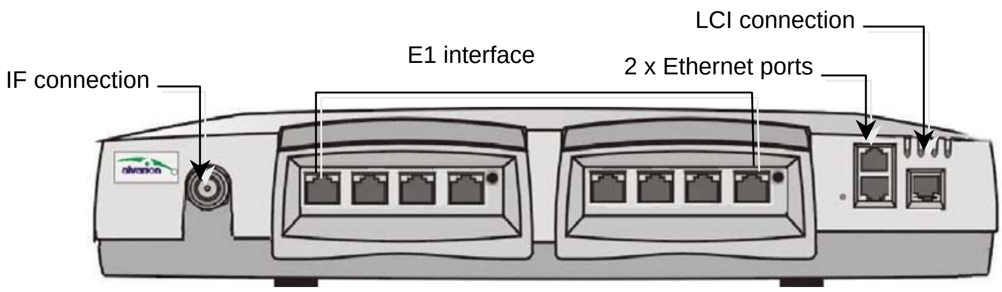


Figure 2-10: Terminal Station Indoor Unit

The Terminal Station Indoor Unit is powered either by a standard DC source (48V) or an AC source.

TS-ODU

The TS ODU includes the RF Head and antenna and is located on a pole with a clear line of sight to the Outdoor Units of the Base Station.

The Terminal Station ODU antenna is attached to the RFU, and is directed toward the Base Station. The IF cable connects the IDU and ODU, supports both the uplink and downlink IF signal, and supplies the ODU with DC power.

The TS ODU supplied depends on the frequency band in which the system will operate.

The **example** shown below is supplied for the 26 GHz band.

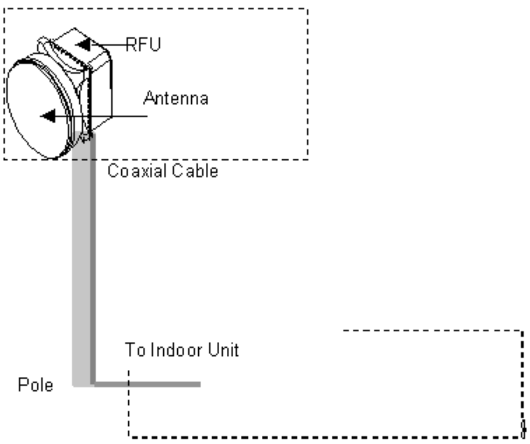


Figure 2-11: Terminal Station Outdoor Unit

NOTE: For 10.5 GHz and 26 GHz systems, the WALKair 3000 BS and TS ODU components are identical to that of the WALKair 1000 BS and TS ODU components, thereby facilitating combined deployment and migration.

System Management Methods

Each BS-SA unit and the TS-BUs under its control may be configured, monitored and managed though a single connecting to the host BS-SA unit. Three management methods are available:

- Local Craft Interface (LCI) – provides local, menu-based management of the connected node (BS-SA and hosted TS-BUs) through a local (RS232) connection to the BS-SA LCI port from a computer running a terminal emulation application (i.e. HyperTerminal).
- Telnet connection – provides single point, remote menu-based management of the connected node through a remote point-to-point connection to the BS-SA from a computer running terminal emulation application for TCP/IP, such as Telnet.
- Network Management System (NMS) – provides SNMP based GUI management of a number of nodes from a central site through *WALKnet*, a GUI based intuitive application.

LCI Management

The LCI management application provides complete configuration and maintenance functions via a local RS232 connection.

LCI is based on layered, menu driven screens that enable the operator to manage the WALKair 3000 system equipment and telecommunications services. The LCI management functions include:

- Configuration Management
    - ➢ Radio Link Management
    - ➢ Administrative Parameters
    - ➢ Services Management
- Maintenance Management
    - ➢ Version Control
    - ➢ Alarm Management
    - ➢ System Testing
    - ➢ Air Performance Monitoring
    - ➢ Modem Management

WALKair 3000's BS LCI provides remote configuration and maintenance functions for all of its connected TSs, enabling full monitoring and remote control over each of the TSs.

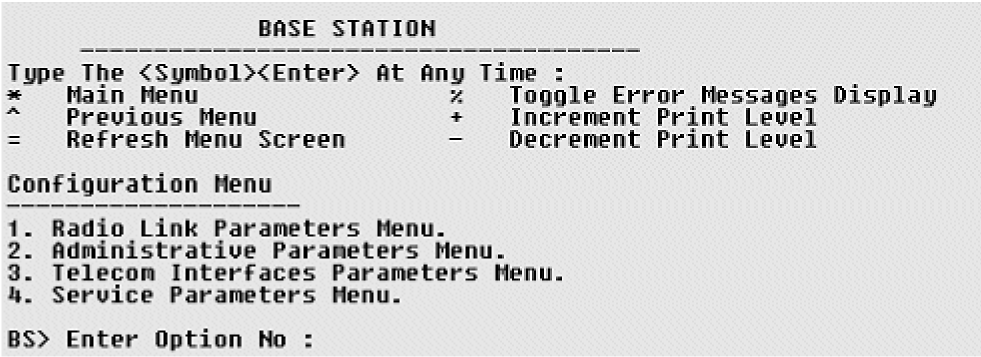


Figure 2-12: LCI Terminal Interface

The LCI provides accurate up-to-date status information regarding the current active services and resources (telecom and air links) utilized by the network elements. Additionally, the LCI terminal is used to retrieve the information stored in the BS-BU and TS-BU, including hardware/software installation data, configuration data, subscriber data and operating parameters.

Remote LCI Management

A BS LCI session can also take control over a specific TS's LCI session, thus saving expensive field maintenance. This can also be used for on-line help to a field technician.

In order to control a specific TS, the operator has to type the TS Customer ID and Password.

The TS operator can resume control over the TS's LCI by pressing any key on its keyboard. The system automatically terminates the remote connection.

NMS

WA 3000 provides out-of-band SNMP based management that can be operated over an HPOV platform or as a standalone application.

The management is implemented by WALKnet, a separate application that can be run on either a NT or UNIX platform.

WALKnet provides complete configuration, maintenance and monitoring capabilities. These include:

- Remote S/W download to the remote terminals
- Automatic failure discovery

- Service statistics and performance monitoring
- Alarm report to higher level management
- Graphical visualization of the NE, zooming functionality
- Central SQL database support
- User security layers

The following figure illustrates remote connection to a BS-SA. The BS-SA serves as a Proxy agent, providing management access to each of the corresponding TS-BUs.

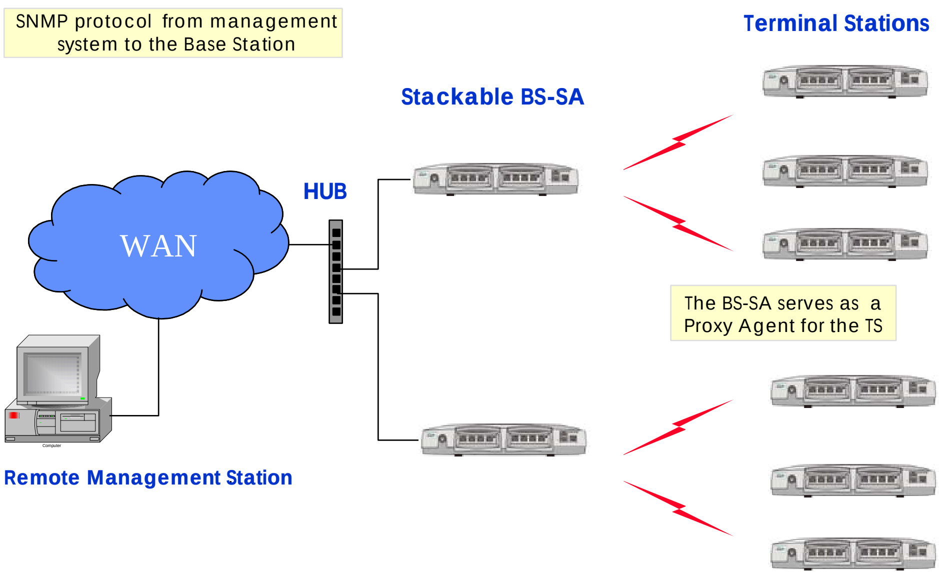


Figure 2-13. NMS Out-of-Band Management

3

Chapter 3 - WALKair 3000 Operator Benefits

In This Chapter:

This chapter describes WALKair 3000 entry points, and includes the following sections:

WALKair 3000 Entry Points

Operators in the 10.5 GHz, 26 GHz and 28 GHz markets need to meet existing customer requirements, while at the same time provide scalable and adaptable solutions.

Alvarion's WALKair 3000 system enables operators to supply the most cost-effective entry level for the customer, according to the customer's current capacity demands and subscriber needs.

Each solution can evolve as a pay-as-you-grow modular architecture, providing flexibility for dynamic growth and development as customer and subscriber requirements change.

The key to structural flexibility is the adaptation of WALKair BS IDU architecture to the actual technical and business case requirements. In addition, the Base Station architecture can be adapted to a specific deployment evolution phase.

WALKair 3000 entry points are designed around two different Base Station Solutions as follows:

- WALKair 3000 BS-SA Solution, on page 3-4.
- Alvarix Integrated Solution, on page **Error! Bookmark not defined.**.

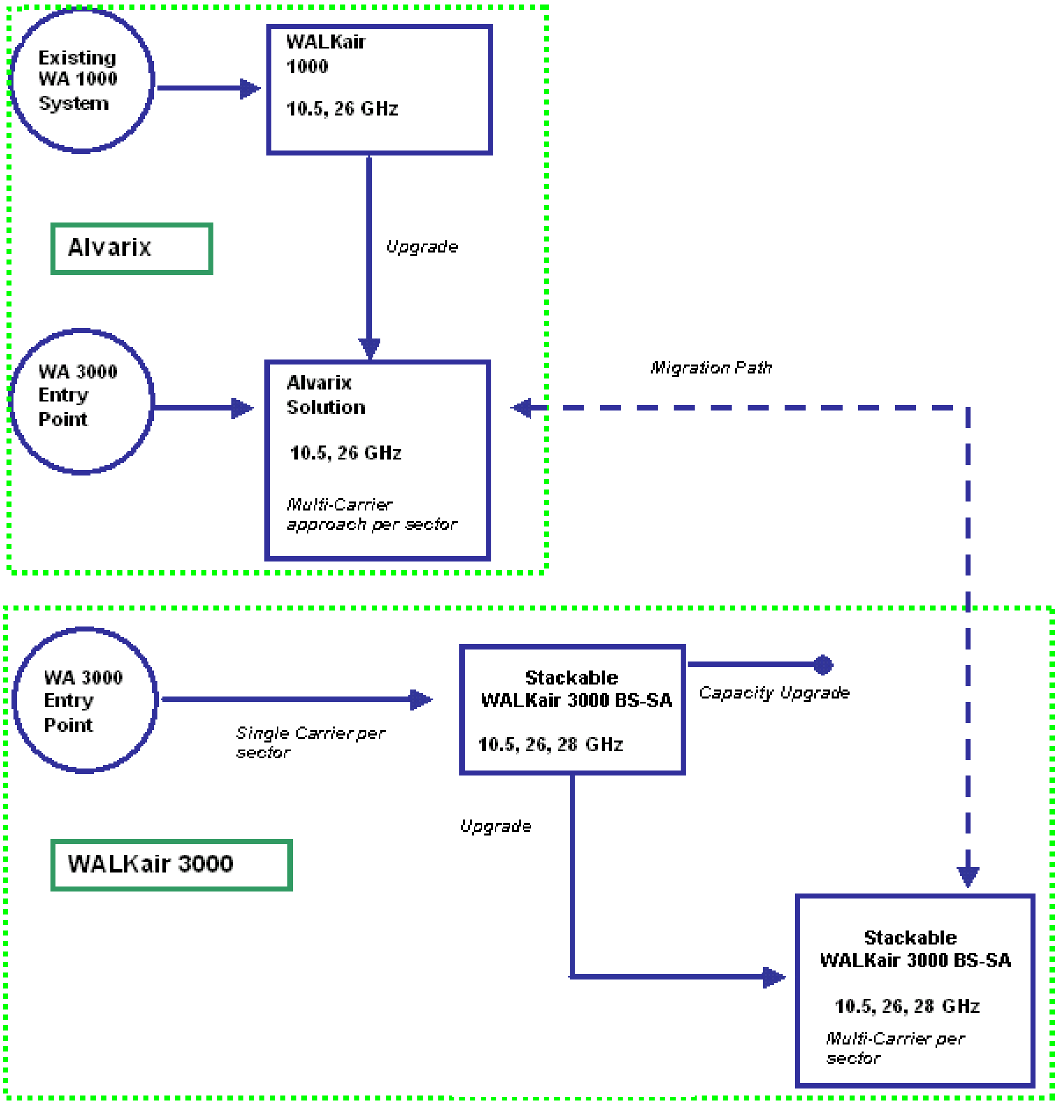


Figure 3-1: WALKair 3000 Entry Levels

WALKair 3000 BS-SA Solutions

BS-SA Entry Points

One Carrier per Sector

This installation provides a single carrier of **34 Mbps** per sector. The installation consists of a BS-SA per RFU.

The BS-SA device provides a single IP/Layer 2 Ethernet connection and up to 8 E1 and TDM/Leased Lines services for up to 64 terminals.

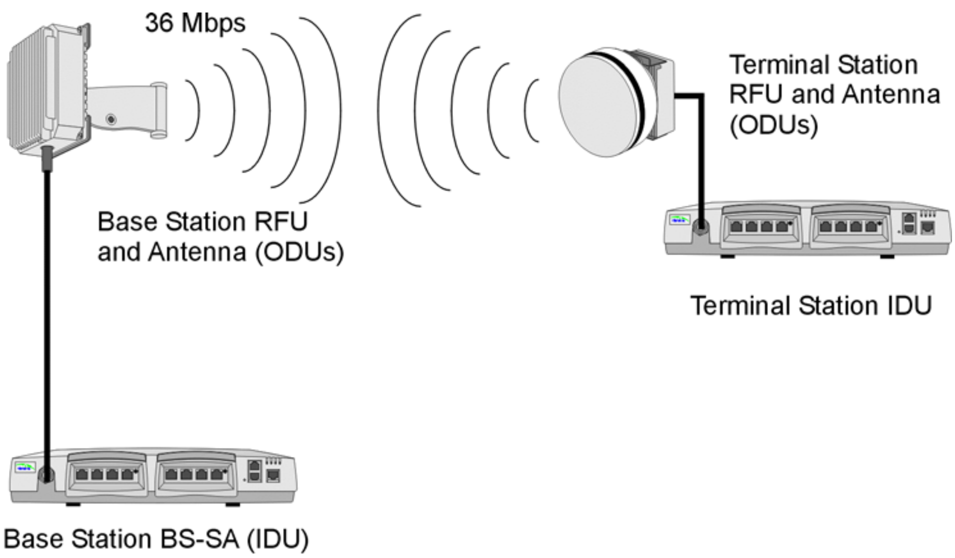


Figure 3-2: BS-SA – One Carrier/Sector

Single Carrier over 180º Coverage

This installation provides **180º coverage** with a single carrier capacity of **34 Mbps** per cell. The installation consists of a BS-SA and two RFUs, each with a 90º antenna. The DE-MUX device is used for supplying a single carrier to both RFUs.

The BS-SA device provides a single IP/Layer 2 Ethernet connection and up to 8 E1 and TDM/Leased Lines services for up to 64 terminals.

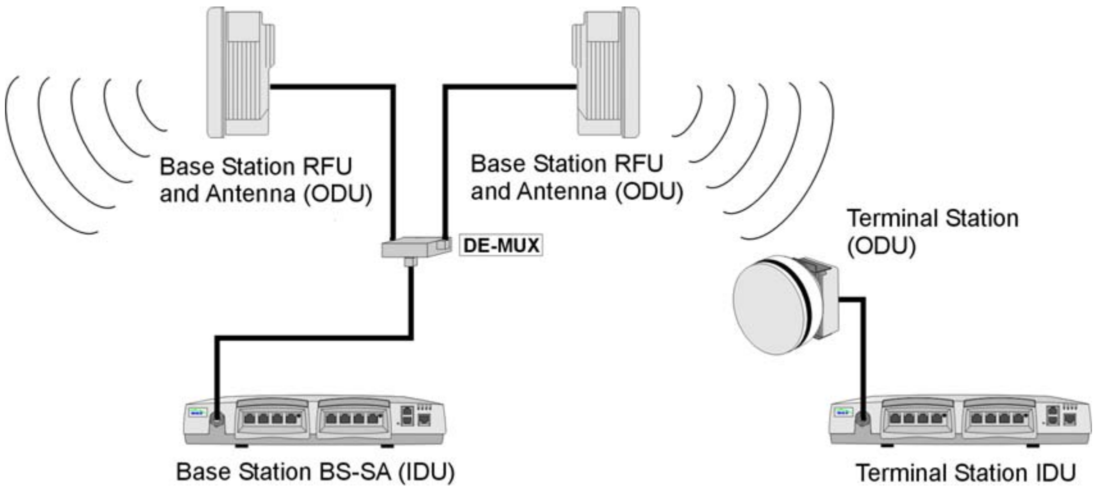


Figure 3-3: BS-SA – 180º Coverage

Two Carriers per Sector Capacity Upgrade

This solution provides **68 Mbps** per sector and supports up to 128 terminals and up to 16 E1 connections. The installation consists of two BS-SAs per sector (RFU).

IF-MUX II is used to multiplex the IF signal transmitted from the two BS-SAs and feed the multiplexed signal to the RFU.

Each BS-SA device provides a single IP/Layer 2 Ethernet connection and up to 8 E1 and TDM/Leased Lines services for up to 64 terminals.

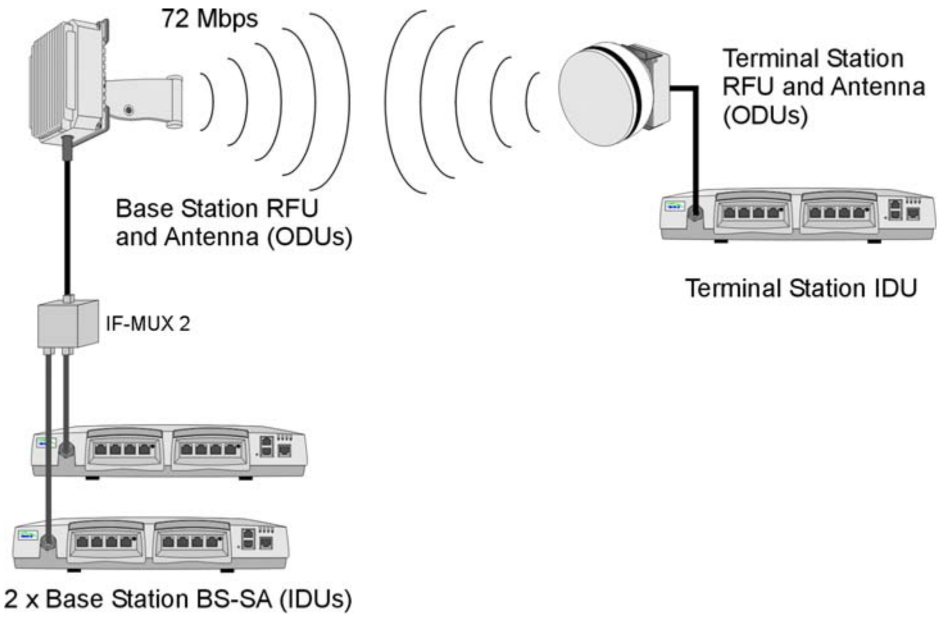


Figure 3-4: BS-SA – Two Carriers/Sector

Up to Four Carriers per Sector Capacity Upgrade

This solution supports three to four carriers per sector. This provides up to 136 **Mbps** per sector and supports up to 256 terminals and up to 32 E1 connections. The installation consists of *four* BS-SAs per sector (RFU).

IF-MUX 4 is used to multiplex the IF signal transmitted from the up to four BS-SAs and feed the multiplexed signal to the RFU.

Each BS-SA device provides a single IP/Layer 2 Ethernet connection and up to 8 E1 and TDM/Leased Lines services for up to 64 terminals.

NOTE: The **LCI** connection of *one* of the BS-SAs is connected to the IF-MUX 4 rear panel **COM** connection.

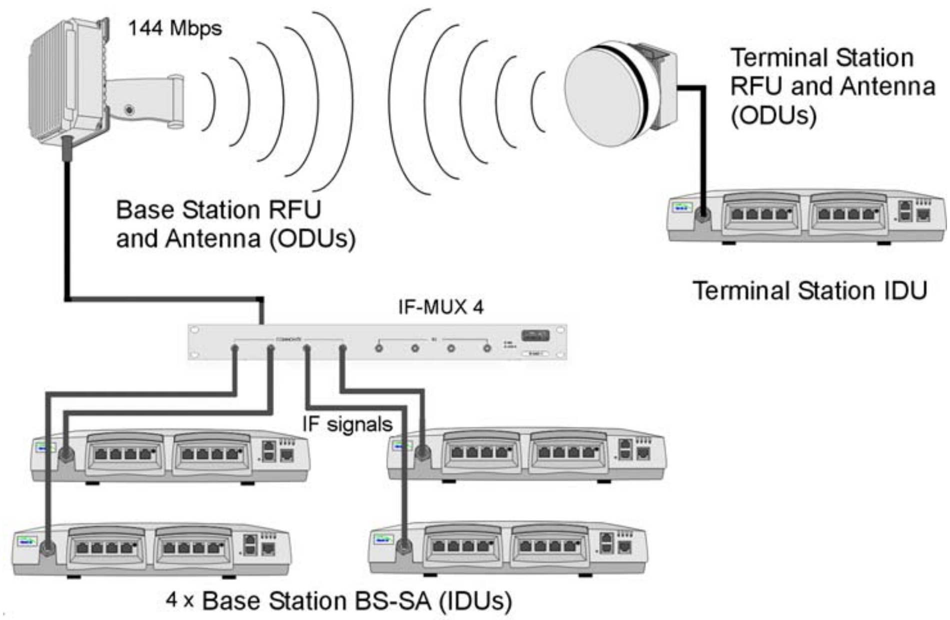


Figure 3-5: BS-SA – Four Carriers/Sector

Alvarix Integrated Solution

Overview

The Alvarix solution enables combining WALKair 1000 and WALKair 3000 operating in the 10.5 GHz and 26 GHz band, to provide optimal price/performance solution by minimizing both CAPEX and OPEX, thus assuring the operator a rapid Return On Investment (ROI), growth potential and maximized profitability.

WALKair 3000 and WALKair 1000 IDUs are connected to the same ODU to provide the operator with better spectrum utilization, a wide range of services and interfaces, and capabilities to enlarge WLL network according to current needs. Both system have the same Network Management application and Radio Planning tool.

A combination of WALKair 1000 and 3000 provides a larger variety of CPEs, with better optimization for different types of customers. Combined, WALKair delivers the best combination of:

- Service and SLA policies via IP, Frame Relay, ISDN and leased lines.
- Higher capacity leveraging spectral efficiency, concentration and higher reuse.
- Cost structure, including scalability and various TS types.
- System solutions, including Carrier Class management systems and automated network planning.
- Future readiness, meeting both current and long term CLEC needs

Alvarix Features and Benefits

Alvarix incorporates a wide range of features and benefits as follows:

- High spectral efficiency (2.5 bits/sec/Hz) in conjunction with high capacity per BS (Up to 1.2 Gbps per cell):
  - ➢ Provides high data rates over a minimal bandwidth, thus allowing the carrier and service provider to efficiently utilize the spectrum and to maximize their revenues by deploying less BSs for a given territory.
  - ➢ Results in less CAPEX and OPEX spending
- Multi-Carrier approach per sector reducing the number of ODUs required:
  - ➢ Reduces OPEX & CAPEX by saving the number of required ODUs, roof-top Base Stations and infrastructure

- Pay-as-you-grow structure:
  - ➢ Enables additional carriers/capacity per sector, as and when needed, by adding only Indoor Units components.
  - ➢ Secures the investment by enabling gradual upgrading
- Modulation scheme: Automatic/Manual dual modulation. (16QAM/QPSK) per Terminal:
  - ➢ Increases the system availability and optimizing the coverage
  - ➢ Improves the operator's business model by increasing the number of Station potential customers per BS
  - ➢ Saves both the operator's CAPEX and the OPEX by eliminating the need to deploy new BSs in order to cover remote customers.
- Smooth integration and migration between the two product lines (WALKair 1000/3000) integrated under Alvarix)
  - ➢ Same ODU and IF components at the TS and BS
  - ➢ Same network management (WALKnet) and Frequency Planning (NIR) tools
  - ➢ Saves the operator OPEX when integration/migration of both product lines is needed

Alvarix Range of Services

Table 3-1: Alvarix Range of Services

Feature	Description
Services	Data ▪ IP/Layer 2 over Ethernet 10/100 BaseT ▪ Frame Relay ▪ ISDN Quad-BRI Voice ▪ V 5.1 (for voice MUX) over E1 ▪ ISDN Quad-BRI ▪ ISDN PRI Leased line; ▪ E1/Fractional E1 ▪ V 35/X.21 PMP cellular backhauling: ▪ Leased lines over E1 for GPRS/GSM feeding ▪ N x E1 IMA for UMTS (3G) feeding.

Table 3-1: Alvarix Range of Services

Feature	Description
Applications	Access applications ▪ Next-generation broadband IP/Layer 2 services ▪ Legacy Voice and Data services ▪ Always on services ▪ End-to-end QoS and SLA ▪ Fiber-to-building concept Feeding application: ▪ Licensed frequency bands ▪ Multiple standard interfaces and services ▪ Reliability Access and feeding: ▪ Largest coverage capacity available ▪ Scalability through diversified Terminal Station and modular, flexible Base Station ▪ Availability BER < 10-9, 99.995% ▪ Carrier class service ▪ Comprehensive network management tool
Applications	Supports diverse segments, applications and multi-services: ▪ Increases opportunities to penetrate new markets and target new customers Converged BWA and Cellular Backhauling Application: ▪ Enables the same BWA PMP infrastructure to be used for both applications increasing the potential businesses and improve the operator's business model PMP Cellular Feeding: ▪ Enhances cost efficiency compared to PTP and leased lines ▪ Saves CAPEX for site acquisition and backhaul through easy integration into wireless sites of the cellular operator ▪ Increases BWA utilization MDU/MTU Access application: ▪ Improves efficient use of trunk equipment ▪ Enables multiple users to share same Terminal Station, leading to shared initial investment (CAPEX) and improvement of the business model.

IF-MUX 4 Alvarix Implementation

The following figure shows Alvarix implementation (and RFU redundancy) using IF-MUX 4. IF-MUX 4 enables the connections of up to four BS-SAs and BS-BU units in any combination. The following figure shows a configuration of two BS-SAs and one BS-BU 1000, in addition to two RFUs to provide RFU redundancy.

NOTE: For clarity, only one BS-BU 1000 unit is shown. If a second BS-BU device is added, its I and R ports will be chained to the first BS-BU and its IF (Tx and Rx) ports connected to the COMMON/Tx and Rx ports on the IF-MUX 4 front panel.

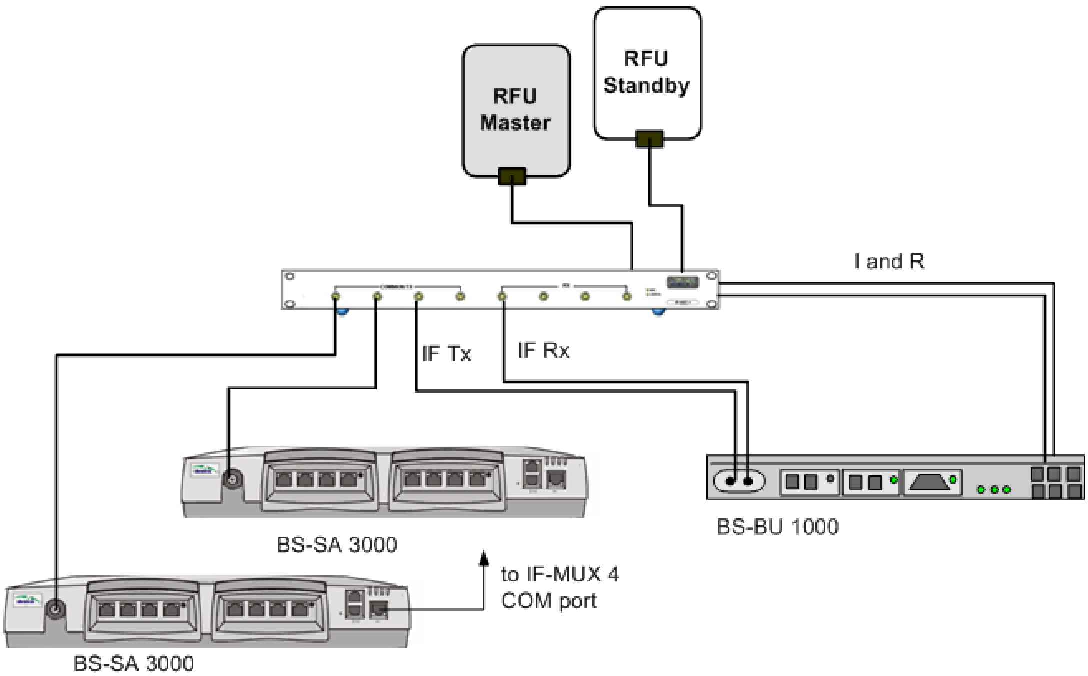


Figure 3-6. Example of Alvarix implementation using IF-MUX 4

Redundancy

WALKair 3000 provides both RFU and BS-SA E1 Telecom interface redundancy support. As shown in Figure 3-7, RFU redundancy is achieved by connecting two RFUs to the IF-MUX 4; BS-SA E1 and management redundancy is achieved by connecting two BS-SAs to an E1 Switch. RFU redundancy information is transmitted by interconnecting the E1 and IF-MUX 4 management connections.

Redundancy is enabled through the WALKnet.

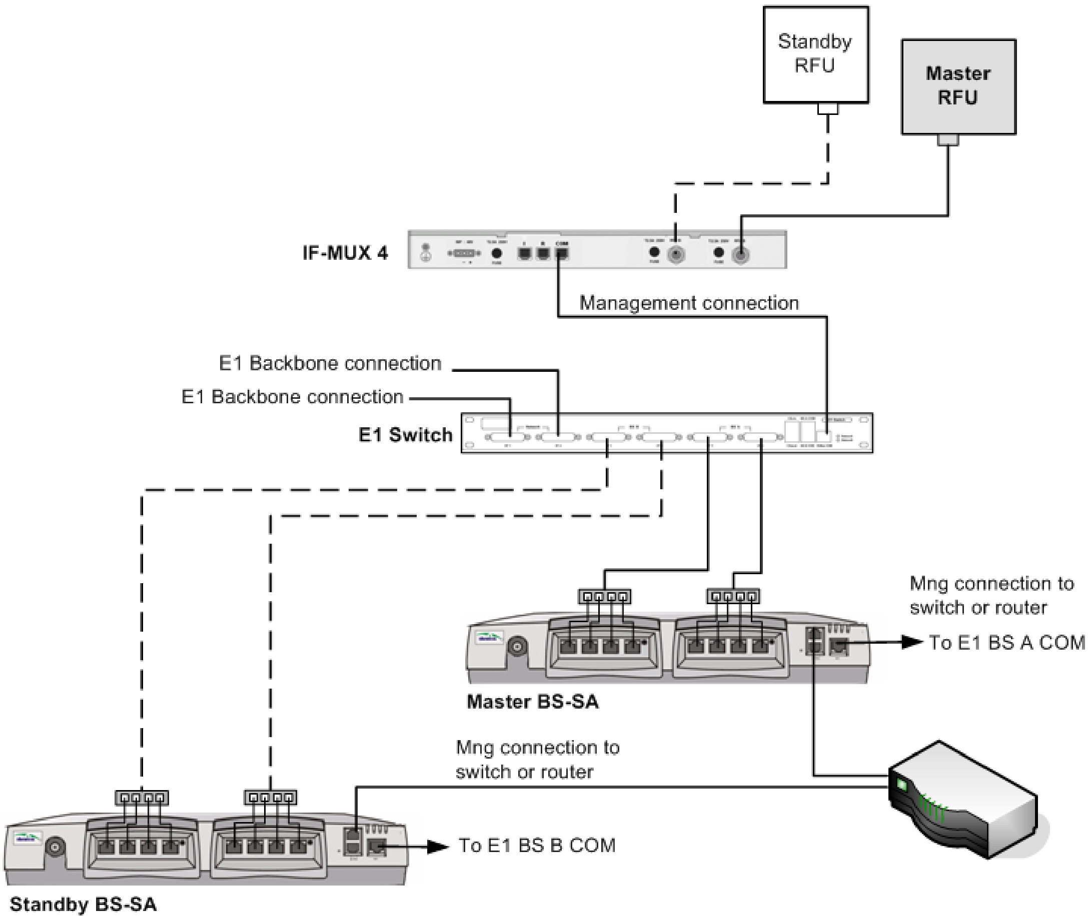


Figure 3-7. Example of Redundancy Implementation

ODU Redundancy

ODU redundancy is implemented by connecting two ODUs (each consisting of an RFU and antenna) to an **IF-MUX 4** unit. Switching is done at the output of the IF MUX.

Redundancy is enabled or disabled through the WALKnet:

- **Automatic Redundancy Mode –** if air link communication in the entire sector is lost for more than ***5 sec***, the ODUs are automatically switched and the standby ODU activated. If upon switching, air link communication is still not detected for ***5 min***, the ODUs are switched again. The procedure is repeated (switching every 5 seconds) until air link communication is detected.
- **Manual Mode –** upon NMS request. The user can manually choose the active RFU. The system will remain in manual mode, that is ODUs will not be automatically switched, until the mode is changed to Automatic.

WALKnet alarms - in the event that a redundant BS RFU is activated, all Terminal Stations in its sector will automatically recover and service will be re-established. An alarm is sent to the NMS, indicating that the redundancy was activated.

IDU Redundancy

IDU redundancy is implemented by connecting the *backbone* and *management* connections of two BS-SAs to an **E1 Switch** and connecting the switch outputs to the backbone.

During normal operation, only the Master BS-SA is activated and its interfaces continuously monitored by the IDU through the COM connection. Redundancy is automatically triggered under any of the following conditions:

- Communication lost on Eth port for more than 30 sec
- Airlinks down for all terminals for more than 2 minutes
- Communication of redundant BS-SA with the Master (BS-SA) lost for more than 5 sec

In the event that a redundant BS-SA is activated, an alarm is sent to the WALKnet, indicating that IDU redundancy was activated.

NOTE: When IDU redundancy is triggered, the switchover to the standby unit is performed. Once the failed BS-SA is replaced, redundancy must be reconfigured through the management.

Flowchart of Redundancy Timing

The following flowchart shows the timing and conditions for ODU and IDU redundancy switchover.

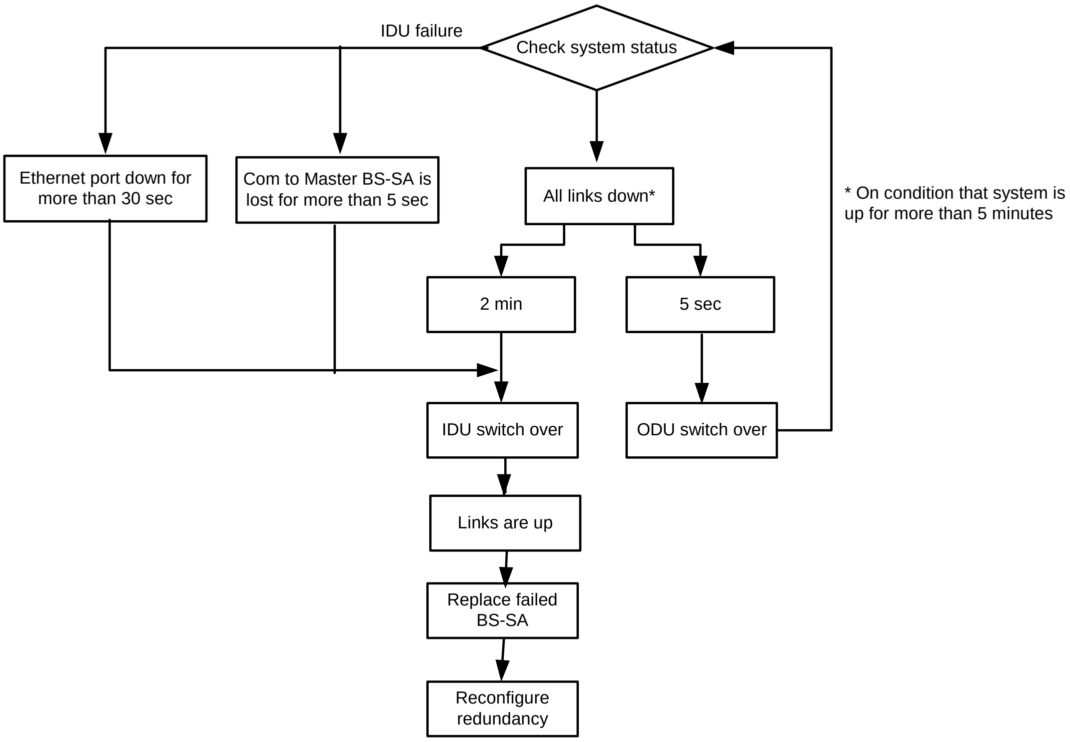


Figure 3-8. Flowchart of Redundancy Timing

4

Chapter 4 - WALKair 3000 Services

In This Chapter:

Overview

WALKair 3000 provides the following types of services:

- IP/Layer 2 services including the full range of data and voice services
- TDM services including leased line CBR (AAL1) and legacy telephony services via TDM PCM or serial bit stream traffic (Full leased line or fractional E1).

End-to-end QoS is implemented for both IP/Layer 2 and TDM services.

IEEE's 802.1Q standard VLAN implementation is used to group clients (networks) belonging to the same TS according to their SLA agreements, optimizing the used bandwidth and providing security between clients.

The DiffServ mechanism is used to differentiate between CoS in the SLAs.

IP Services over WALKair 3000

WALKair 3000 is specifically designed to deliver end-to-end QoS required for all IP/Layer 2-based applications including fast Internet and voice services. The following sections provide a detailed description of the IP/Layer 2 data service concept of the WALKair 3000 system. In addition, the sections describe the WALKair 3000 IP/Layer 2 and QoS service implementation by explaining the end-to-end IP data flow with its associated QoS.

Ethernet Modes in WALKair 3000

- Port Type: Crossed on the TS/ Crossed on the BS
- Speed (configurable): 10BaseT/100BaseT
- Duplex (configurable): Full/Half duplex
- Speed and Duplex Auto-detection (configurable)
- Tagging (configurable on TS): Tagged/Untagged on TS, Always tagged on BS

Security and VLANs

WALKair 3000 uses VLAN 802.1Q mechanism to allocated each client (client) a dedicated VLAN with its associated IP subnet. This establishes complete separation and security established between clients connected to the same TS.

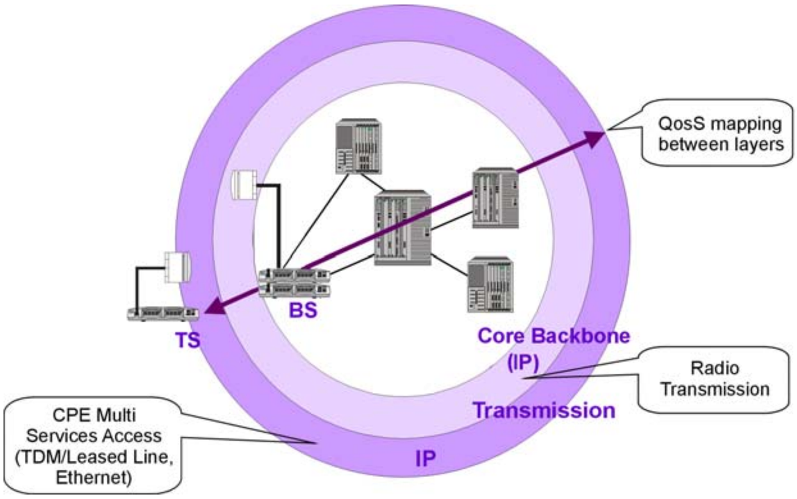


Figure 4-1: IP Network Concept

IP traffic from the CPE side is mapped from its specific VLAN and IP subnet to a specific IP path toward the backbone, over the airwaves, according the customer SLA, which ensures the required end-to-end QoS.

As illustrate by the following figure, each TS can be configured with up to 16 **Service Level Agreements (SLAs)** and each client (network) is configured with one of the 16 SLAs configured to the TS. Each SLA in the same TS is associated a different VLAN tag that carries information about the TS ID and VLAN ID. (If there is only one client (network) on a TS, it can work in untagged mode (saving a L2 switch).)

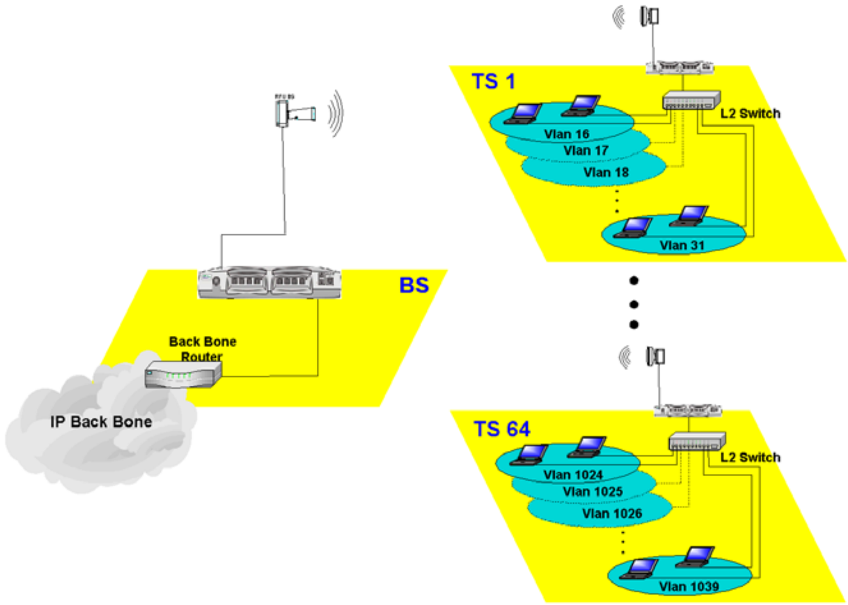


Figure 4-2. Configuring SLAs According to VLAN IDs

A number of TSs may be configured to common VLAN IDs; however, the TS and BS VLAN ID do not have to be the same. Mapping between the TS and BS VLAN IDs is performed by the WALKaire 3000 system. The SLA definition includes the following information:

- **Service level attributes** – consists of Class of Service (CoS) that defines the number of prioritized queues the client can use, and the required bandwidth characteristics that is defined (defined by **CIR** and **MIR**).
- **Client ID** - The customer identification in the associated TS.
- **Service pipe endpoints** – TS ID and TS Port ID to which the client is connected, and the Ethernet port of the BS-SA.
- **TS VLAN ID** - unique VLAN ID (802.1q standard) assigned to each SLA per TS. This value is used by the TS to differentiate traffic belonging to different SLAs.
- **BS VLAN ID** - unique VLAN ID (802.1q standard) per BS, which is used by the BS to differentiate traffic belonging to different SLAs, and to perform the forwarding decision to the proper TS to which the client is connected.

IP Flow Mechanism

The following description refers to Figure 4-3 and details the traffic flow in the uplink path. In the downlink path, the *opposite* process occurs.

The IP packet from PC1 (towards the air) has an Ethernet MAC address with the Router as the destination, and an IP address with PC2 as the destination. Either PC1, the VLAN switch (shown in the figure) or a router, optionally tags the IP packets with a VLAN tag (with VLAN ID).

The TS Ethernet port may be configured as tagged or untagged. Within the WALKair 3000 system (from the TS, over the air link and at the Base Station end), the IP traffic is always tagged. If the TS Ethernet port is configured as untagged, the TS assigns a VLAN tag with TS VLAN ID. If the VLAN ID was attached to the frame before the TS, the TS sends this tag over the air. In either case, this will be the TS VLAN tag.

The TS performs Ethernet bridging at Layer 2. Ethernet traffic destined to hosts which the TS recognizes as residing on the local LAN is not forwarded over the air link. Ethernet traffic destined to any host residing beyond the Base Station, such as PC2, is forwarded over the air link.

At the Base Station end, the air cells are received by the BS-SA and are reassembled to 802.1q packets, and the VLAN ID is translated into the BS VLAN ID of the SLA. The packet from the Base Station to the Router has its MAC source address = PC1 its IP source address. The Router transmits the packet, over the Backbone to PC2, based on IP routing rules.

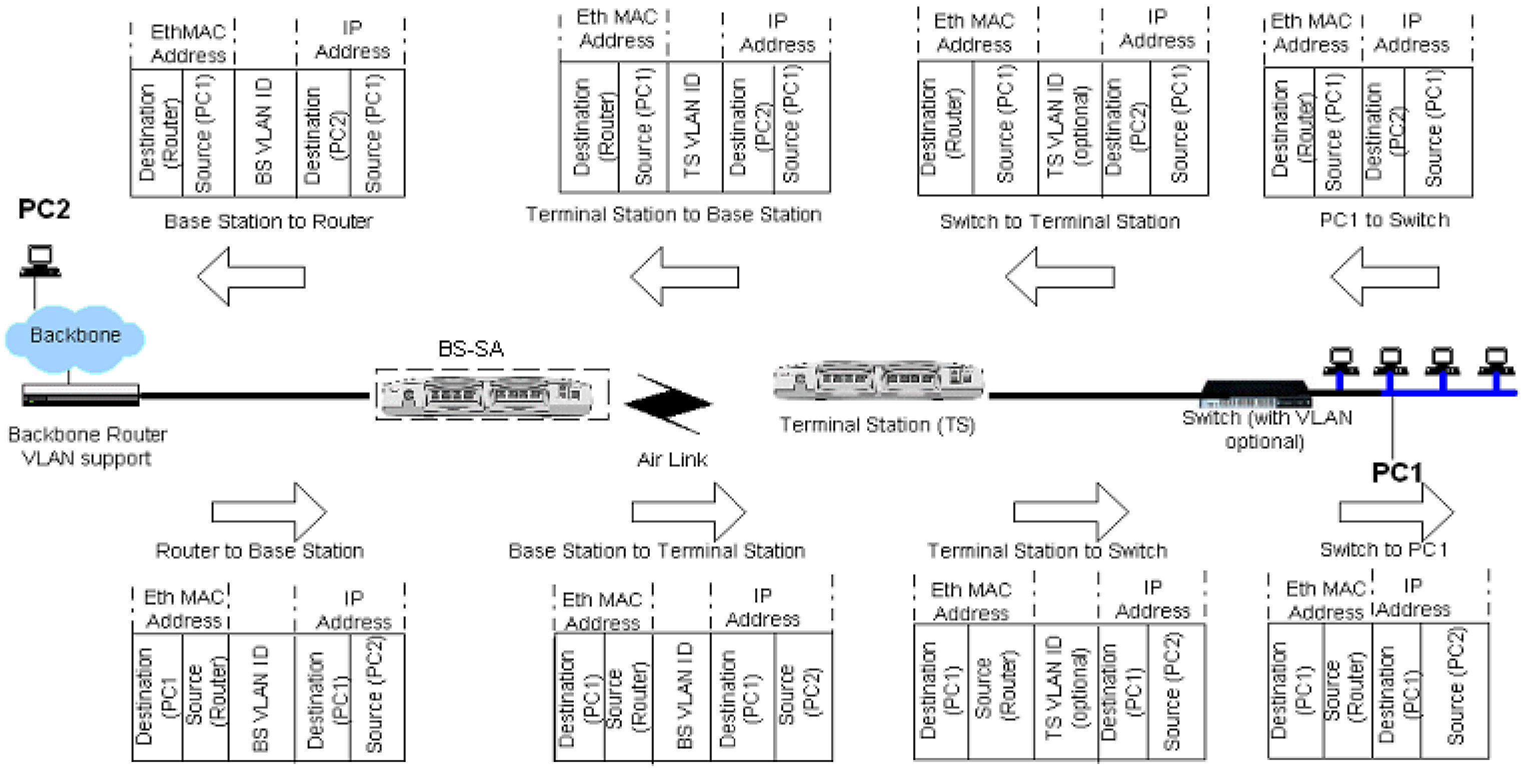


Figure 4-3: IP Traffic flow and QoS in WALKair 3000

WALKair 3000 End to End QoS

Background

Different applications (i.e. voice, data, video) have different requirements from the network. For example, while voice and video applications would require a guaranteed bandwidth and do not suffer packet loss, data based applications can retransmit lost packets. While delay affects voice and video applications, it is not significant in data applications.

Since IP networks have unexpected dynamic behavior that cause congestions and packet loses, QoS is required for voice and video applications.

QoS is provides set of techniques to manage:

- Bandwidth - The perceived width of the pipe
- Delay - The perceived length of the pipe
- Jitter - The perceived variation in the length
- Packet Loss - The perceived leak in the pipe

A QoS aware network provides pre-negotiated per-hop behavior (bandwidth allocation and/or latency) and enables the network to optimize resources by servicing applications efficiently without affecting function or performance.

This is done by allocating bandwidth according to each SLA. At each output port, packets of different priorities are queued at distinct queues, where lower priority packets are served only if all higher priority queues are empty and low latency and jitter is provided for the highest class.

The different IP streams received from each client at the TS are classified, prioritized and shaped according the client's SLA content. The SLA is based on the following parameters:

- **CIR** – Committed Information Rate
- **MIR** - Maximum Information Rate
- **Up to 4 CoS levels** - an aggregate of up to four prioritized queues that can be configured per client.

QoS Implementation in WALKair 3000

To enforce the client's SLA, the TS implements the following mechanisms:

- Traffic is classified into SLAs according to the 802.1q VLAN tag.
- Traffic is policed to conform to the CIR and MIR defined in the customer's SLA.
- Traffic is further classified according to its DiffServ DSCP value, and sent via 1 to 4 prioritized queues.

Each queue is assigned a different priority level according to the traffic type:

Queue Priority	Traffic Type
3	Voice
2	Video
1	Data
0	Data – Best Effort

The number of queues is determined by the CoS level defined in the SLA. Refer to Table 4-1 on page 4-9 for the CoS level profiles and their typical traffic characteristics and applications.

Packets that are *within CIR* are directed to the appropriate queue. Priority level 2 and 3 packets that *exceed CIR* but are within MIR are discarded, while priority 1 packets are directed to queue 0. Packets that exceed the MIR, are discarded. The packet priority level is identified according to **DiffServ** standard.

To maintain required QoS and small constant delay/jitter (for the highest prioritized traffic), traffic is segmented into fixed-size air cells, and a sophisticated priority queuing algorithm is used, interleaving cells of different prioritized queues before sending them over the air.

The following figure illustrates and summarizes the mechanisms used to implement QoS in WALKair 3000 (i.e. SLA, policing, priority queuing algorithms and **DBA** over the air).

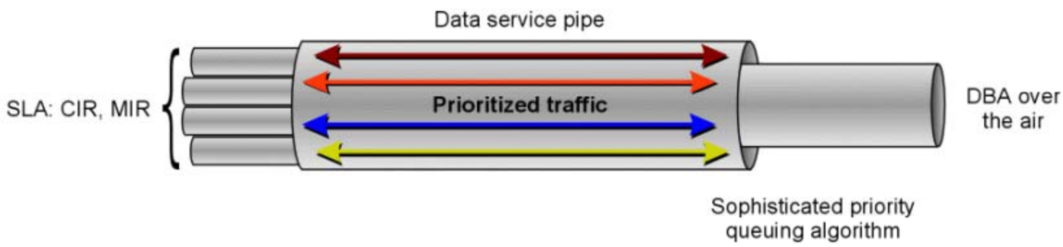


Figure 4-4: QoS Implementation in WALKair 3000

Class of Service (CoS) Definitions

The WALKair 3000 IP service assigns each client an SLA with one of four possible **Classes of Service (CoS)**. The CoS is defined by the number of queues it supports: four queues for the highest (Platinum) CoS and a single queue for the lowest (Bronze) CoS. The queue are of varying priorities in order to optimize resources for various types of applications.

The following table summarizes the CoS and queue types.

Table 4-1: CoS Level Profiles

Class of Service	Traffic Characteristics	Goal	Applications
Platinum (4 prioritized queues)	Important multimedia	Very low latency, B/W guarantee and limit	VoIP
Gold (3 prioritized queues)	Important applications – interactive, transactional. Predictable traffic	Low latency, B/W guaranteed	Video conferencing, database and financial transactions.
Silver (2 prioritized queues)	Important applications – interactive, transactional or informational. Less predictable traffic	Medium latency, segregated, B/W guaranteed	Video on Demand, HTTP traffic, collaborative applications
Bronze (Lowest priority queue – Best Effort)	Batch applications, long TCP sessions and everything else	High latency, acceptable throughput, limited network impact using remaining bandwidth	FTP traffic, application replication, data backup, email and all other traffic.

Examples of IP SLA Scenarios

Figure 4-5, Figure 4-6 and Figure 4-7 show three IP SLA **example** scenarios:

- No TS Local Router installed
- TS Local Router installed with different subnet
- TS Local Router installed with same subnet

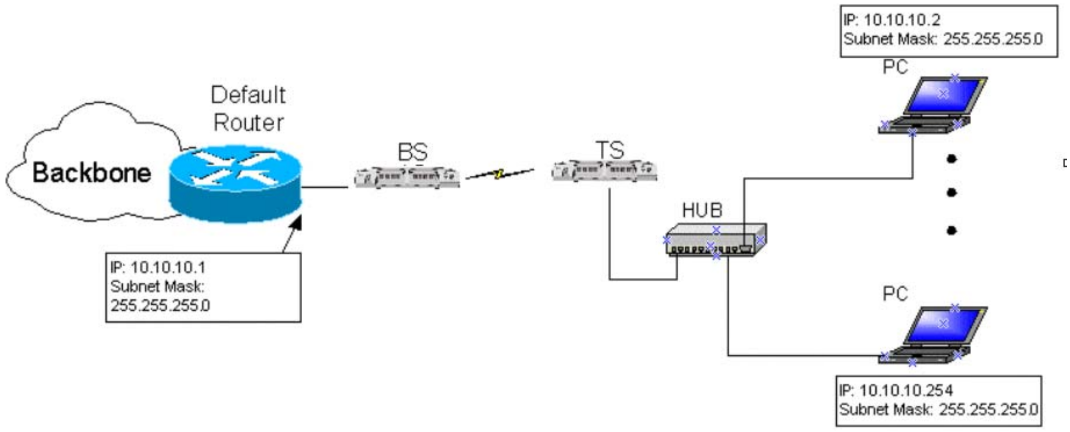


Figure 4-5: No TS Local Router Installed (example)

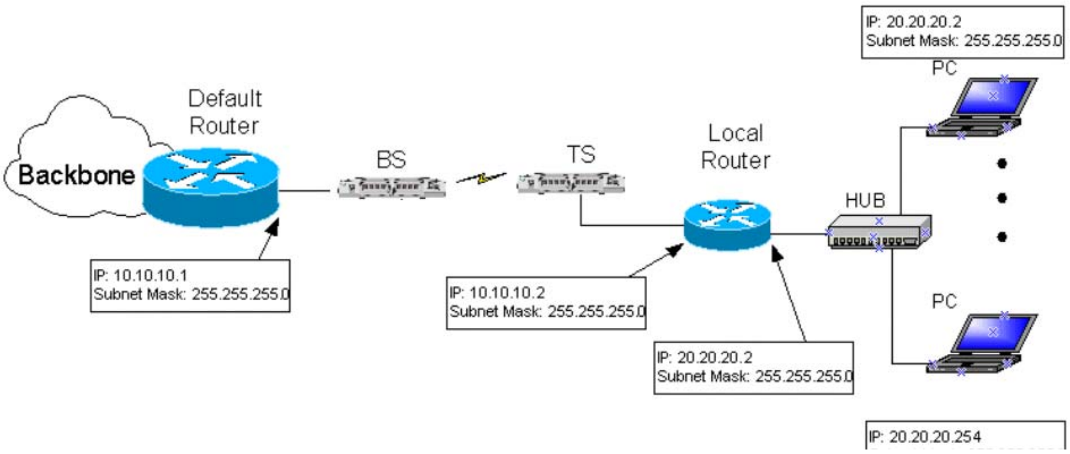


Figure 4-6: Different Subnet Behind TS Local Router (example)

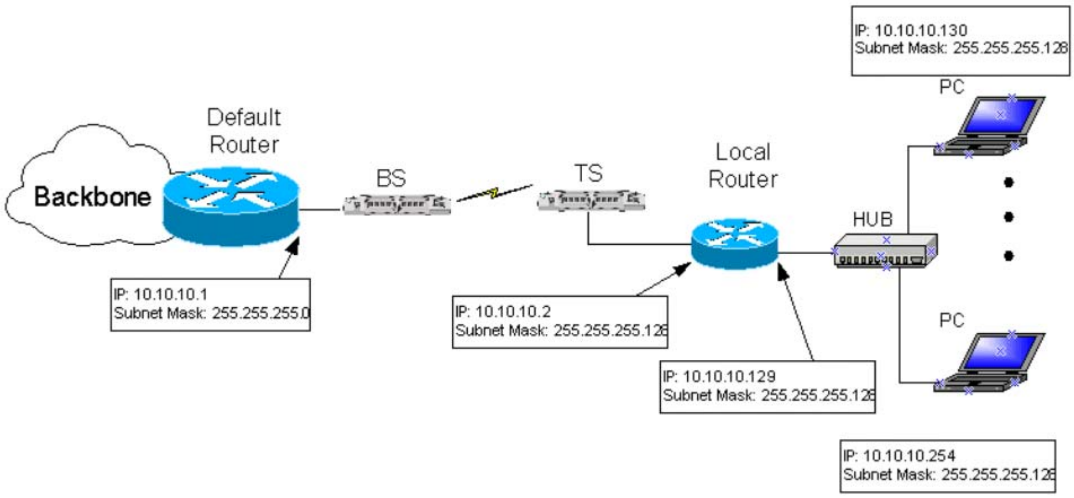


Figure 4-7: Same Subnet Behind TS Local Router (example)

Service Definition Structure

Each service definition is composed of:

- **Client parameters** - client identification in the associated TS
- **SLA parameters -** Set of SLA parameters agreed upon between the client and the operator. The actual CoS which is provided by the operator
- **Service properties -** To accomplish system end-to-end service definition

As detailed in the following table, IP SLA Parameters consist of a database of 16 IP SLA IDs per TS, where each SLA is defined according to the CIR, MIR and CoS level corresponding to the SLA agreed upon between the client and operator.

Table 4-2: SLA Parameters:

Parameter	Description
TS ID	The identification of a specific TS (1-64)
IP SLA ID	The IP SLA index identification (1-16) per TS
TS and BS VLAN ID	VLAN IDs for TS and BS (flexible for Layer 2 operation)
CIR	Committed Information Rate
MIR	Maximum Information Rate
CoS Levels	Bronze, Silver, Gold and Platinum. Client types identified by the number of prioritized queues allocated (1-4)

As detailed In the following table, IP SLA properties consist of the SLA definitions and configuration for provisioning the required services to the client.

Table 4-3: SLA Properties:

Parameter	Description
Client ID	The customer identification in the associated TS
IP SLA ID	The IP SLA index identification assigned to each client per TS
TS Port ID	The number of the physical Ethernet 10/100 BaseT port of the associated TS
VLAN ID	Each SLA is assigned a unique VLAN ID (802.1Q standard), which is used as the mapping identification for the service (flexible for Layer 2 operation)

Service Hierarchy Structure Per TS

Each TS can support up to 64 clients (networks), where each client is identified by an index ID and a logical name.

Thirty-two different SLAs are available: 16 IP SLA/Data service pipes and 16 Leased-Line/TDM SLAs. Each TS supports up to 16 SLAs and each client is associated with one of the available SLAs.

To provision a service an SLA is assigned to a specific client residing on a Terminal Station and associated with a specific VLAN.

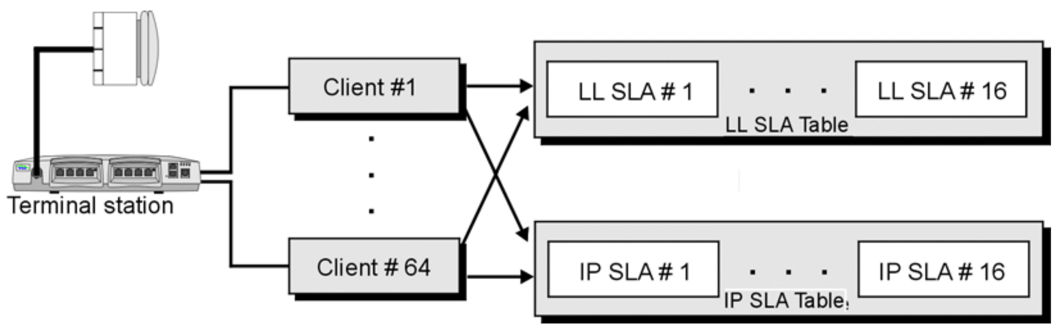


Figure 4-8: Service Hierarchy Per TS

DBA QoS over the Air

WALKair 3000 utilizes **Dynamic Bandwidth Allocation (DBA)** to effectively meet the demands of bursty IP traffic and concentrate the traffic over the available bandwidth. Dynamic bandwidth allocation is performed **simultaneously** for all of the services associated with the TSs (up to 64) per carrier.

DBA characteristics are:

- Air bandwidth (34 Mbps) allocation per client on a specific TS changes dynamically.
- DBA is based on the actual traffic rate as defined in the SLAs per TS and its clients.
- DBA ensures a fair bandwidth share to all clients on the various TSs, based on their service attributes and their SLAs.
- Unused MIR, CIR bandwidth is shared among active clients that are assigned to the same carrier. In this scenario, bandwidth granularity is 256Kbps.
- Different IP packet lengths ranging from 64 to 1518 Bytes, is fragmented to a fixed air cell size. Cell switching is performed over the air.
- To maintain deterministic delay/jitter for the highest prioritized traffic (VoIP) and to keep the required QoS over the air, the following mechanisms are implemented:
  - ➢ The DBA per client and TS is performed according to the actual required CIR and MIR as derived from the active SLAs.
  - ➢ The packets are segmented to a fixed air cell size.
  - ➢ The cells from the different prioritized queues are interleaved before being sent over the air. This is done to ensure that the cells that are arriving from the higher prioritized queues are sent first. In this way, the sophisticated priority queuing algorithm is implemented.

IP Traffic and End-to-End QoS

In order to provide enhanced IP services all the network should support QoS and the IP backbone should support DiffServ standard.

The IP traffic, with its QoS (DiffServ), is forwarded from the BS-SA, via its Ethernet port, directly to the IP backbone. All IP routers at the backbone use the DiffServ information carried by each IP packet to allocate the backbone bandwidth resources while maintaining the required end-to-end QoS.

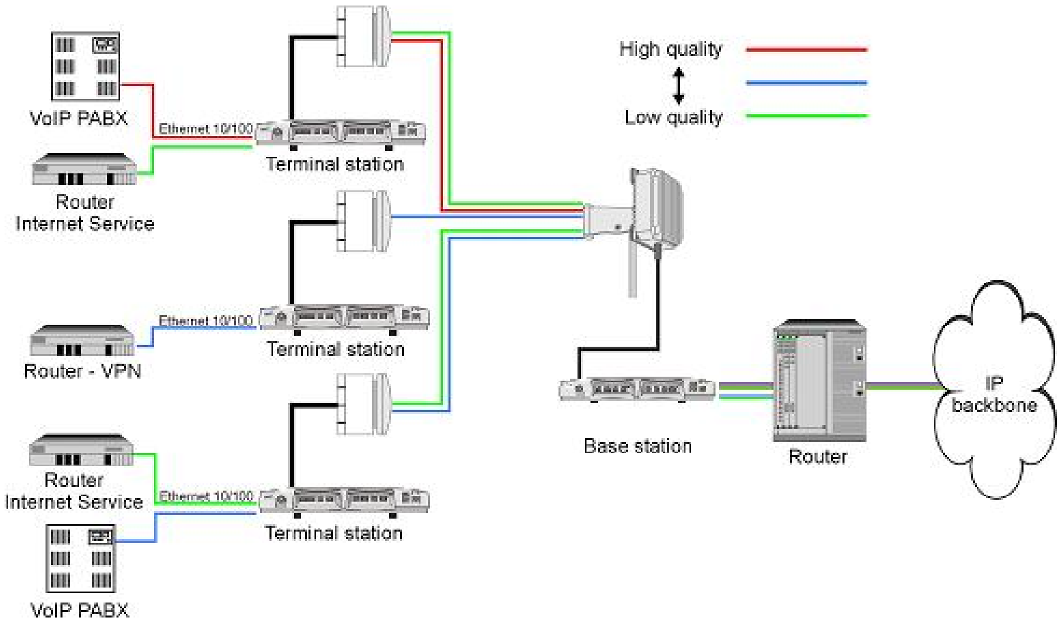


Figure 4-9. QoS Implementation in WALKair 3000

Description of End-to-End QoS

The following section comprises a detailed **step-by-step** description of the uplink and downlink IP Traffic and QoS flows, as shown in Figure 4-10.

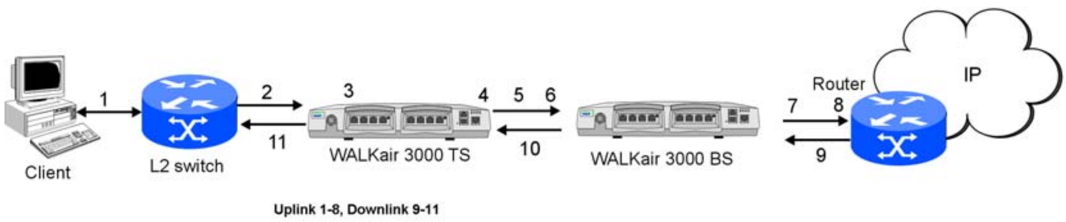


Figure 4-10: IP Traffic and QoS Flow

In the Uplink Path:

1. Each client is associated with a unique VLAN with a unique IP subnet within one carrier. The client's users are connected to the TS Ethernet port via an L2 switch or IP router.

Each client is assigned a specific SLA which reflects the client bandwidth and CoS requirements. The SLA properties are derived from the traffic stream types, bandwidth and CoS level that is needed for the applications used by the client.

2. The client's VLAN ID is configurable. The client's VLAN ID tag is unique within the same carrier and serves to identify the client for all forwarding decisions made within the system.

   The IP packets can be tagged by the client's hosts or by the TS itself. Therefore, the TS Ethernet port has to be configured to tagged or untagged mode, as required.

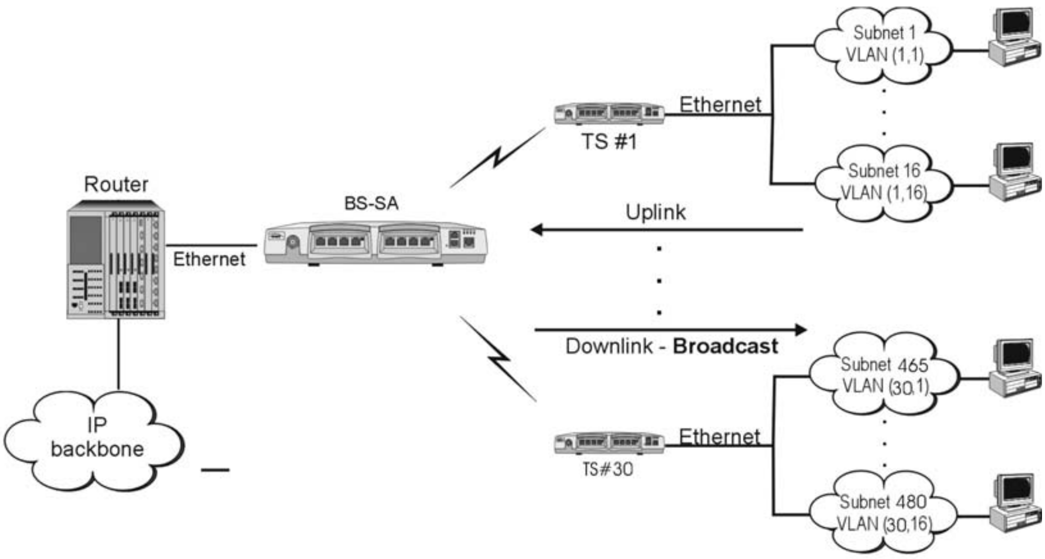


Figure 4-11: IP Flow

NOTE: Referring to the above figure, the first number in brackets after VLAN refers to the TS ID, and the second number refers to the SLA ID.

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3. The TS performs the forwarding/filtering decisions, which means that the router spoofing functionality is implemented, as follows:

   - Local IP traffic is filtered.
   - Local host MAC addresses and their associated IP addresses are stored in the TS ARP/LAN tables, along with an indication of which TS port is associated with the client.
   - Non-local IP traffic, is forwarded to the backbone.

To enforce the client's SLA, the TS implements the following mechanisms:

- Policing on the customer's IP flows in accordance with the MIR and CIR in the customer's SLA.
- Classifying the IP traffic by its DiffServ
- prioritizing the IP traffic to up to 4 prioritized queues, depending on the CoS level, as configured in the client's SLA.

4. To maintain the required QoS over the air to maintain a constant delay/jitter for the highest prioritized traffic type, the following mechanisms are implemented:

- Segmentation
- Sophisticated Priority Queuing Algorithm
- DBA per client and TS is performed according to the actual required CIR and MIR as derived from the active SLAs.
- The IP traffic cells are attached over the air by the 3000 Air Header (~2 Bytes) that includes the VLAN ID and packet priority for further forwarding decisions within the BS-SA. In addition, the overhead contains cell order information so that the fragmented IP packet can be reassembled at the BS.

5. Each TS sends its IP data to the BS in a bursty fashion. The bursts are arranged in successive order according to the TS IDs, which range from 1 up to 64 per carrier.

The air frame structure carries the following information:

- Link synchronization
- DBA mechanism
- Payload - data cells

6. The air cells are received at the BS-SA and reassembled to IP packets, while the 3000 Air Header is detached.

In the Downlink Path:

- The BS-SA forwards the IP string coming from the backbone to the appropriate TS according to the VLAN
- BS-SA performs policing, classification and prioritizing functions on the IP traffic flows, similar to those described in step 3.

E1 Services

E1 is a European digital transmission format devised by the ITU-T and given the name CEPT. The E1 signal format carries data at a rate of 2.048 million bits per second and can carry 32 channels of 64 Kbps each. E1 is a full duplex standard.

Leased Line Services (SDH/PDH Backbone)

The E1 service supports TDM traffic flows from the Base Station to the Terminal Stations.

The BS-SA card maps the E1 channels to Air Time Slots and then the data sent over the air to the TS.

The data is then sent over the air to the TS.

Each Terminal Station receives the data broadcast transmission of the BS BU. It selects the corresponding Air Time Slots using the framer and passes the traffic to E1 ports.

In the Uplink, the Terminal Station receives the traffic over the E1 port and send it to BS over the air. The BU at the Base Station sends the traffic to the E1 card.

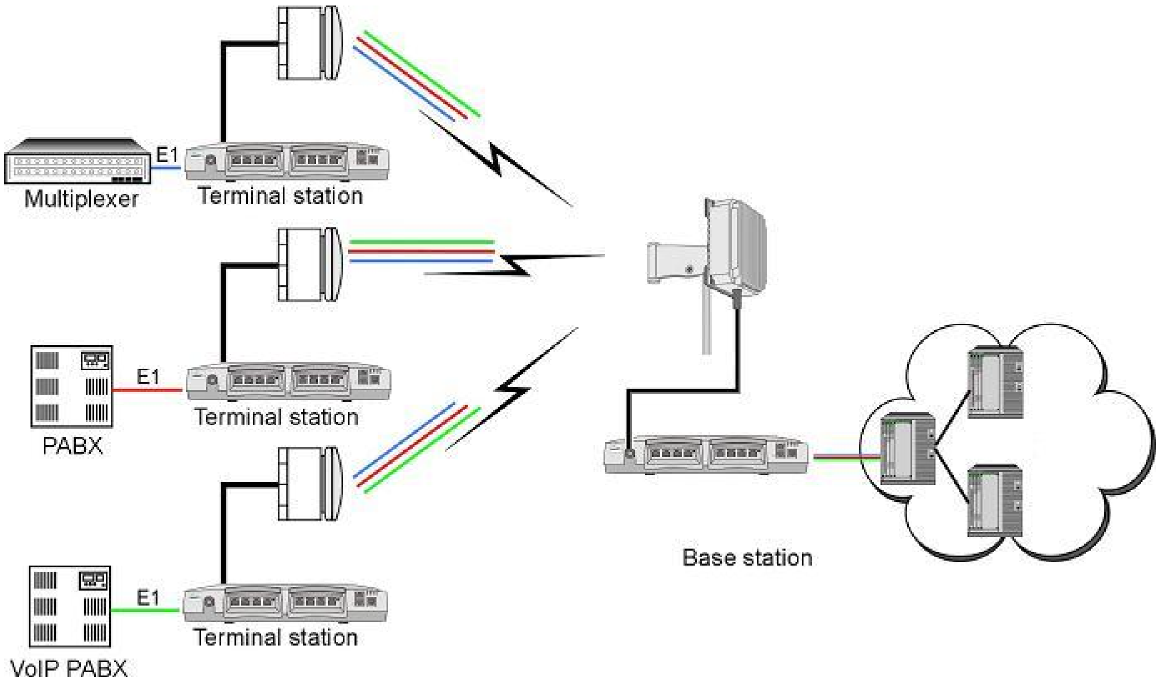

Figure 4-12. WALKair 3000 Leased Line Services

TDM Clock

TDM services require clock synchronization. To meet these requirements, all the BS-SA units must be synchronized on one clock source.

WALKair 3000 provides Primary and Secondary clock source configuration options. The clock source can be internal clock, or external clock from an E1 port. The TSs receive the clock from the BS via the air link.

E1 Modes in WALKair 3000

- Framed – No CRC. (Synchronization on double-frame, doesn't require synchronization on multi-frame)
- Framed – CRC. Requires synchronization on mutliframe
- Framed – CRC extended. Attempt to synchronize on multi-frame;if failed - attempt to synchronize on double-frame
- Unframed. Doesn't synchronize on time slot 0, synchronizes on clock only. Handles data as continuous 2048Mbps bit stream.

E1 Alarms

Loss Of Signal	LOS
Loss Of Frame Alignment	LOF
Loss Of Multi-Frame Alignment	LOMF
Alarm Indication Signal (All '1's)	AIS
Remote Alarm Indication	RAI

5

Chapter 5 - Specifications

In This Chapter:

- General specifications of the WALKair 3000 system
- Specifications of each of the main devices in the WALKair 3000 system. For example, E1, IF-MUX 4, etc.

WALKair 3000 General Specifications

Table 5-1: WALKair 3000 General Specifications	
Parameter	**Value**
ETSI Standards	--ETSI TM4 (EN 301 021) --ETSI TM4/2
CEPT/ERC Rec. 14-03	10.5 GHz ETSI ▪ Uplink (TS TX): 10.500250 – 10.649875 GHz ▪ Downlink (BS TX): 10.150250 – 10.299875 GHz 10.5 GHz CEPT ▪ Uplink (TS TX): 10.500500– 10.650000 GHz ▪ Downlink (BS TX): 10.150500 – 10.300000GHz
CEPT/ERC T/R 13-02 Annex B	26 GHz --Uplink (TS TX): 25.557 - 26.453GHz --Downlink (BS TX): 24.549 - 25.445GHz 28 GHz --Uplink (TS TX): 28.5565 – 29.4525 GHz --Downlink (BS TX): 27.5485-28.4445 GHz
Chinese RF Band	Uplink (TS TX): 25,869 - 26,653GHz Downlink (BS TX): 24,619 - 25,403GHz
Radio: **(EN 301 021 26GHz)**	--General: EN301213-1 --TDMA: EN301213-3 --Antenna: EN301215-1, EN301215-2
Environmental:	--ODU complies with class 4.1E as per ETS 300 019-2-4. --IDU complies with class 3.2 as per ETS 300 019-2-3.
Safety:	EN 60950:1992 + A1: 1993 + A2: 1993 +A3: 1995+A4: 1997 standard requirements for compliance with Low voltage Directive 72/73/EEC.
Harmonics and Flicker:	--EN61000-3-2 “Limits of Harmonic Current Emissions (equipment input current <16 A per phase)” --EN61000-3-3 “Limits of Voltage Fluctuations and

Table 5-1: WALKair 3000 General Specifications	
Parameter	**Value**
	Flicker in Low-Voltage Supply Systems for Equipment with Rated Current <16 A”
EMC **(EMC Directive 89/336/EEC):**	▪ EN 300 386-2:1997 ▪ EN 300 385:1998 ▪ EN 300 132:1996 ▪ EN 310 021:1998. Alvarion products with the CE marking comply with the EMC Directive (89/336/EEC). Compliance with this directive implies conformity to the following European Norms: ▪ EN 55022 “Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment”. Tested to Equipment Class A. ▪ EN 50082-1: 1997 “Electromagnetic Compatibility—Generic Immunity Standard, Part 1, Residential, Commercial, and Light Industry”.
Lightning Protection:	--EN 61000-4-5 and ETS 300381-1 for outdoor and indoor components --ENV 50142 AC port
FCC Class A:	WALKair 3000 equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. Changes or modifications not expressly approved by Alvarion could void the user’s authority to operate the equipment. Use only shielded cables when connecting peripherals to assure that appropriate radio frequency emissions compliance is maintained.

Table 5-1: WALKair 3000 General Specifications	
Parameter	**Value**
Radio Access Method	TDMA/FDD
Modulation and Coding Technique	Dual modulation: 16QAM/QPSK @ Reed Solomon FEC
Net Payload **per Single User**	64Kbps to 34 Mbps/16 Mbps down for 16QAM/QPSK
Carrier Bandwidth	14, 7 and 3.5 MHz **NOTE:** 3.5 MHz bandwidth is supported only for 10.5 GHz band and requires different hardware to be implemented.
Channel Spacing	14Mhz channel according to T/R 13-02 Annex B. 10.5 GHz The system supports center frequency resolution of 875kHz 26 GHz The system supports center frequency resolution of 875kHz if it can fit in the RF heads (112MHz x 8 RF heads). 28 GHz The system supports center frequency resolution of 1750 kHz if it can fit in the RF heads (224 MHz x 4 RF heads).
Frequency sub-bands	10.5 GHz -- FDD Separation: 350 MHz 26 GHz --112 MHz x 8 RF heads. Sub-band edges on 112 boundaries according to T/R 13-02 Annex B and Chinese bands --FDD separation: 1008MHz according to T/R 13-02 Annex B or 1250MHz in China 28 GHz --224 MHz x 4 RF heads. Sub-band edges on 224 boundaries according to T/R 13-02 Annex B FDD separation: 1008MHz according to T/R 13-02 Annex B
Spectral Efficiency	--2.5bit/sec/Hz @ 16QAM --1.15bit/sec.Hz @ QPSK
Sector Coverage	From 50 meters to 10 kilometers depending on the

Table 5-1: WALKair 3000 General Specifications	
Parameter	**Value**
	frequency
Carriers per Sector	--1 to 4 carriers @ 1 RFU ODU --Up to 8 carriers @ 2 RFU
Carrier Capacity	At 14 MHz: ▪ 34 Mbps/16 Mbps for 16 QAM/QPSK. ▪ Terminal Station capacity of 64 Kbps to 34 Mbps/16 Mbps for 16 QAM/QPSK. At 7 MHz: ▪ 16 Mbps/8 Mbps for 16 QAM/QPSK. ▪ Terminal Station capacity of 64 Kbps to 16 Mbps/8 Mbps for 16 QAM/QPSK. At 3.5 MHz : ▪ 8 Mbps/4 Mbps for 16 QAM/QPSK. Terminal Station capacity of 64 Kbps to 4 Mbps/8 Mbps for 16 QAM/QPSK.
Frequency Bands and sectors	▪ 10.5 GHz with 60° and 90° sectors ▪ 26 GHz with 45° ,90 and 180° sectors 28 GHz with 45°, 90° and 180° sectors
Interfaces	Base Station (network side): ▪ Ethernet 10/100 Base T for an IP/Layer 2 backbone ▪ Up to 8 x E1 for an E1 SDH backbone Terminal Station side: ▪ 2 x Ethernet 10/100 Base T ports ▪ Quad E1 Telecom modules - Optional 4 or 8 E1 ports (8 x E1 Telecom module to support 16xE1 per BS-SA is planned for the year 2005)
Data rate	For 14 MHz channels - up to 34 Mbps (upstream and downstream) per Terminal Station (10.5/26/28 GHz) For 7 MHz channels - up to 16.384 Mbps (upstream and downstream) per Terminal Station (10.5/26/28 GHz) For 3.5 MHz channels - up to 8.192 Mbps (upstream and downstream) per Terminal Station

Number of Terminal Stations per Sector	Up to 240
System Capacity per Base Sector	--Up to 272 Mbps (8x34 Mbps) @ 112MHz allocation --Up to 408 Mbps (12x34 Mbps) @ 168MHz allocation
System Capacity per Base Station	--2176Mbps (64x34 Mbps) @ 112MHz allocation --3264Mbps (96x34 Mbps) @ 168MHz allocation
Supported Distance	--10.5 GHz: up to 10 km at line of sight for 16QAM/QPSK --26 GHz: 3km/5km at line of sight for 16QAM/QPSK --28 GHz: 3km/5km at line of sight for 16QAM/QPSK
MBTF	--The MTBF of the WALKair 3000 (IDU and ODU) is 200,000 hours (about 25 years).

Base Station Specifications

General

Table 5-2: Base Station General Specifications	
Parameter	**Value**
BS-SA	Dimensions: --Width (mm): 220 --Height (mm): 44.5 --Length (mm): 350 --Input Voltage: 48 VDC
Antenna (ODU) 26 GHz	--Standards: complies with EN 301 215-1 and EN 301 215-2, Type CS1 --Type: Horn antenna --Dimensions (mm): 287x235x40 --Weight (kg): 2.25 --Beamwidth: 45^0 (vertical or horizontal) --Beamwidth: 90^0 (vertical or horizontal) --Beamwidth: 180^0 (vertical or horizontal)
RFU (ODU) 26 GHz	--Revision: Rev A --Dimensions (mm): 220 x 270 x 100 --Weight (kg): 7.0
Antenna (ODU) 28 GHz	Dimensions (inches) = (18 x 3.5 x 3.5) + (16.5 x 6.25 x 0.55) --Weight (kg): 2.25. --Beamwidth: 45^0 (vertical or horizontal) --Beamwidth: 90^0 or 180^0 (vertical or horizontal)
RFU (ODU) 28 GHz	Dimensions (inches) 6.25 x 16.5 x 1.625
RFU + Antenna (ODU) 28 GHz	Weight of RFU/Antenna/Mounting Bracket assembly combined (kg) = 13.2

Table 5-2: Base Station General Specifications	
Parameter	**Value**
Antenna 10.5 GHz	Dimensions (mm): 60 ° Vertical - 440 x 290 x 150 60 ° Horizontal - 440 x 290 x 130 90 ° Vertical and Horizontal - 320x100x15 Weight (kg): 60 ° (Vertical and Horizontal) = 2.5 Kg 90 ° (Vertical and Horizontal) = 1.6 Kg
RFU (ODU) 10.5 GHz	--NJRC Rev C Dimensions (mm): --3325x270x156 Weight (kg): 10.1 (including mounting kit)

BS-SA Specifications

Table 5-3: BS-SA Specifications	
Parameter	**Value**
Frequency Bands and sectors:	10.5 GHz with 60° and 90° sectors 26 GHz with 45° , 90° and 180° sectors 28 GHz with 45°, 90° and 180° sectors.
Interface – Base Station (network side):	Ethernet 10/100 Base T for an IP/Layer 2 backbone Up to 8 x E1 for an E1 SDH backbone
Interface – Terminal Station:	2 x Ethernet 10/100 Base T ports Optional 4 or 8 E1 ports (Quad E1 Telecom modules) 8 E1 is planned for the year 2005.
Polarization:	Up to 4:1 frequency re-use with single and dual polarization
Channel spacing:	14 MHz per carrier 7 MHz per carrier (planned for future) 3.5 MHz per carrier (planned for future)
Spectral efficiency:	Maximal - 2.5 bits/s/Hz.
Modulation Scheme:	Adaptive and manual dual modulation scheme (16 QAM/QPSK)/Terminal Station
Access method:	FDD TDMA access method supporting up to 30 Terminal Stations per carrier

Table 5-3: BS-SA Specifications	
Parameter	**Value**
Carrier capacity:	@ 14 MHz: ▪ 34 Mbps/16 Mbps for 16 QAM/QPSK. ▪ Terminal Station capacity of 64 Kbps to 34 Mbps/16 Mbps for 16 QAM/QPSK. @ 7 MHz (planned for future): ▪ 16 Mbps/8 Mbps for 16 QAM/QPSK. ▪ Terminal Station capacity of 64 Kbps to 16 Mbps/8 Mbps for 16 QAM/QPSK. @ 3.5 MHz (planned for future): ▪ 8 Mbps/4 Mbps for 16 QAM/QPSK. ▪ Terminal Station capacity of 64 Kbps to 8 Mbps/4 Mbps for 16 QAM/QPSK.
Sector capacity:	Up to 136 Mbps per sector (four carriers, implemented using IF-MUX 4)

Table 5-4: BS-SA Services and Interfaces	
Parameter	**Value**
Services:	TDM/Leased Lines IP/Layer 2
Interface - Network side:	4 or 8 E1 lines for an E1/SDH backbone Ethernet 10/100 Base T for an IP/Layer 2 backbone.
Interface - RF:	Supports up to 2 x BS RFUs with DE-MUX for a single sector

Base Station Radio Frequencies @ 10.5 GHz

Table 5-5: Base Station Radio Frequencies @ 10.5 GHz		
Parameter	**Value**	
Guiding Standard	TBD	
Frequency Band	Downlink	Uplink
10.5 GHz Etsi	10150.25 to 10299.875	10500.25 to 10649.875
10.5 GHz CEPT	10150.50 to 10300.00	10500.50 to 10650.00
Output Power	Nominal 22dBm per carrier	
Receive Sensitivity @ 14MHZ channel	-87dBm (@ BER 10^{-9}) for QPSK -81dBM (@ BER 10^{-9}) for QAM 16	
RF Bandwidth	3.5 MHz, 7 MHz, 14 MHz,	
FDD Separation	350MHz	
Antenna Coverage	60˚, 90˚ sectors Vertical and Horizontal	
Antenna Size	See Antenna 10.5 GHz on page 5-8	
Antenna Gain	18dBi (60˚), 15dBi (90˚)	
Standard Compliance	ETSI EN 301 021	

Base Station Radio Frequencies @ 26GHz

Table 5-6: Base Station Radio Frequencies 26 GHz		
Parameter	**Value**	
Guiding Standard	T/R 13-02	
Frequency Band	Downlink	Uplink
	Band A: 24549 to 24661 Band B: 24661 to 24773 Band C: 24773 to 24885 Band D: 24885 to 24997 Band E: 24997 to 25109 Band F: 25109 to 25221 Band G: 25221 to 25333 Band H: 25333 to 25445	25557 to 25669MHz 25669 to 25781MHz 25781 to 25893MHz 25893 to 26005MHz 26005 to 26007MHz 26117to 26229MHz 26229 to 26341MHz 26341 to 26453MHz
Chinese Frequency Bands	Downlink	Uplink
	Band A1: 25869 to 25981 Band B1: 25981 to 26093 Band A2: 26093 to 26205 Band A3: 26205 to 26317 Band B2: 26317 to 26429 Band C1: 26429 to 26485 Band C3: 26541 to 26597 Band C4: 26597 to 26653	24619 to 24731MHz 24731 to 24843MHz 24843 to 24955MHz 24955 to 25067MHz 25067 to 25179MHz 25179 to 25235MHz 25291 to 25347MHz 25347 to 25403MHz
Output Power	Up to 15dBm per carrier	
Receive Sensitivity	-83.3dBm (@ BER 10^{-9}) for QPSK -77dBM (@ BER 10^{-9}) for QAM 16	
RF Bandwidth	Multiple 14MHz (1 to 4)	
Antenna Coverage	4, 8 sectors	
Antenna Size	20cm diameter horn	
Antenna Gain	18dBi (45˚), 15.5dBi (90˚),18 dBi (180˚)	
Standard Compliance	EN 301 215-1 and EN 301 215-2, Type CS1	

Base Station Radio Frequencies @ 28GHz

Table 5-7: Base Station Radio Frequencies 28 GHz

Parameter	Value	
Guiding Standard	T/R 13-02	
Frequency Band	Transmit, MHz	Receive, MHz
A	27548.5 to 27772.5	28556.5 to 28780.5
B	27772.5 to 27996.5	28780.5 to 29004.5
C	27996.5 to 28220.5	29004.5 to 29228.5
D	28220.5 to 28444.5	29228.5 to 29452.5
Output Power	Up to 21dBm per carrier	
Receive Sensitivity	-81dBm (@ BER 10^{-9}) for QPSK -75dBm (@ BER 10^{-9}) for QAM 16	
RF Bandwidth	Multiple 14MHz (1 to 6)	
Antenna Coverage	45˚, 90˚, 180˚ sectors	
Antenna Size	45x8.75x8.75cm^3	
Antenna Gain	24dBi (45˚), 21dBi (90˚), 19dBi (180˚)	
Standard Compliance	EN 301 215-1 and EN 301 215-2, Type CS1	

Additional BS Devices Specifications

E1 Switch Specifications

Capabilities	Redundancy between two BS-SAs, where redundancy is applied to the following elements of each BS-SA: ▪ 16 E1 lines of each BS-SA ▪ BS-SA to IF-MUX 4 communication channel ▪ Reference clock 'Keep alive' – messaging mechanism relays specific messages to the standby BS-SA as backup to the Ethernet channel.
Interfaces	▪ Input power is 48V input (nominal). ▪ 16 primary 120 Ohm E1 interfaces on two D-sub HD 44pin, one of the connectors includes also reference input clock – connectors are *indicated as A* ▪ 16 secondary 120 Ohm E1 interfaces on two D-sub HD 44pin, one of the connectors includes also reference input clock – connectors are *indicated as B* ▪ 16 *Networ*k 120ohm E1 interfaces on two D-sub HD 44pin, one of the connectors includes also reference input clock – – connectors are *indicated as Networ*k (The switch is from the Network port to the primary or the secondary) ▪ Three RJ45 ports are used for RS232 communication between the two BS-SAs and the IF-MUX 4 ▪ Reference clock input and output. Output clock is derived directly from Input clock
LEDs	Two bi-color LED's on the front panel: **Status A LED:** ▪ Red – No Master message received for 30 sec. ▪ Green – BUSA A is master **Status B LED:** ▪ Red – No Master message received for 30 sec. ▪ Green – BUSA B is master
Connections	BS-SA connections - the E1-Switch connects two BS-SAs through 2 8xE1 cables and one RS232 for LCI (per BS-SA). IF-MUX 4 connections – the IF-Mux 4 Ports is connected to the E1-Switch by using a RS232 cable. Network connections – E1 is connected to the network, using two 8xE1 cables and clock in/out for system sync.
Environment	▪ Indoor installation (-5º C to 45º C).
EMC & Safety	▪ EN60950 EN :1,2,3,4 - safety

standards	▪ EN 300386-2 - CE standard. ▪ EN61000-4-1/2/3/4/5 - ESD/EFT/Surges/immunity ▪ ETS300019 - Environmental
Mechanics	▪ Enclosure: 'Pizza' box (1U). ▪ All connectors, except 48V inlet, are located on the front panel. ▪ 48V inlet is located on the rear panel.

Terminal Station Specifications

General

Table 5-8: Terminal Station General Specifications	
Parameter	**Value**
Terminal Station (IDU)	Dimensions: --Width (mm): 220 --Height (mm): 44.5 --Length (mm): 350 Input Voltage: 110/220 VAC or 48 VDC
RFU + Antenna (ODU) **10 GHz**	Dimensions (mm) 260x260x80 Weight (kg): 4.3: Antenna Beam Width: 8° vertical and horizontal
Antenna (ODU) **26 GHz**	--Standards: Complies with EN 301-215-1 and EN 301-215-2, type TS1. --Type: Dish antenna --Dimensions (cm): Standard – 30.5 diameter --Dimensions (cm): High Gain – 61 diameter --Weight (kg): Standard – 7.7 including mount --Weight (kg): High Gain – 12.3 including mount --Polarization: vertical or horizontal
RFU (ODU) **26 GHz**	--Dimensions (mm): 287 x 220 x 90 --Weight (kg): 5.8 Kg
RFU and Antenna (ODU) **28 GHz**	--RFU Body (mm): diameter: 82.5, depth: 128 --RFU Plate (mm) 205 x 205 --RFU Bracket (mm) 330 x 220 --Dish antenna (cm): 30.5/45.7/61 diameter --Weight of RFU/antenna/mounting bracket combined (kg) = 10.2 (for 30.5 cm antenna)

TS Radio Frequencies @ 10.5 GHz

Table 5-9: Terminal Station Radio Frequencies @ 10.5 GHz		
Parameter	**Value**	
Guiding Standard	TBD	
Frequency Band	Downlink	Uplink
10.5 GHz Etsi	10150.25 to 10299.875	10500.25 to 10649.875
10.5 GHz CEPT	10150.50 to 10300.00	10500.50 to 10650.00
Output Power	+22dBm for QPSK +20dBm for QAM	
Receiver Sensitivity **@ 14MHZ channel**	-87dBm (@ BER 10^{-9}) for QPSK -81dBM (@ BER 10^{-9}) for QAM 16	
RF Bandwidth	14MHz, 7MHz, 3.5 MHz	
FDD Separation	350MHz	
Antenna Size	•Integrated RFU & Antenna: 25 x 25 x 3 cm • Flat Microstrip Antenna	
Antenna Beam Width	8° vertical and horizontal	
Antenna Gain	25dBi	
Standard Compliance	ETSI EN 301 021	

TS Radio Frequencies @ 26 GHz

Table 5-10: Terminal Station Radio Frequencies 26 GHz

Parameter	Value	
Guiding Standard	T/R 13-02	
Frequency Band	Downlink	Uplink
	Band A: 25557 to 25669 Band B: 25669 to 25781 Band C: 25781 to 25893 Band D: 25893 to 26005 Band E: 26005 to 26007 Band F: 26117to 26229 Band G: 26229 to 26341 Band H: 26341 to 26453	24549 to 24661MHz 24661 to 24773MHz 24773 to 24885MHz 24885 to 24997MHz 24997 to 25109MHz 25109 to 25221MHz 25221 to 25333MHz 25333 to 25445MHz
Chinese Frequency Bands	Downlink	Uplink
	Band A1: 24619 to 24731 Band B1: 24731 to 24843 Band A2: 24843 to 24955 Band A3: 24955 to 25067 Band B2: 25067 to 25179 Band C1: 25179 to 25235 Band C3: 25291 to 25347 Band C4: 25347 to 25403	25869 to 25981MHz 25981 to 26093MHz 26093 to 26205MHz 26205 to 26317MHz 26317 to 26429MHz 26429 to 26485MHz 26541 to 26597MHz 26597 to 26653MHz
Output Power	Dynamic range -20dBm to +15dBm for QPSK Dynamic range -14dBm to +13dBm for QAM	
Receiver Sensitivity @14MHZ channel	-83.3dBm (@ BER 10^{-9}) for QPSK -77dBM (@ BER 10^{-9}) for QAM 16	
RF Bandwidth	14MHz, 7MHz	
Antenna Beam Width	2.5˚ vertical and horizontal	
Antenna Gain	35dBi, 41dBi	
Standard Compliance	EN 301 215-1 and EN 301 215-2, Type TS1	

TS Radio Frequencies @ 28 GHz

Table 5-11: Terminal Station Radio Frequencies 28 GHz		
Parameter	**Value**	
Guiding Standard	T/R 13-02	
Frequency Band	**Transmit, MHz**	**Receive, MHz**
A planned for the future **B planned for the future** **C** **D**	28556.5 to 28780.5 28780.5 to 29004.5 29004.5 to 29228.5 29228.5 to 29452.5	27548.5 to 27772.5 27772.5 to 27996.5 27996.5 to 28220.5 28220.5 to 28444.5
Output Power	Dynamic range -35dBm to +15dBm for QPSK Dynamic range -35dBm to +13dBm for QAM	
Receiver Sensitivity @14MHZ channel	-82dBm (@ BER 10^{-9}) for QPSK -75dBm (@ BER 10^{-9}) for QAM	
RF Bandwidth	14MHz	
Antenna Beam Width	1.2° to 2.5° vertical and horizontal	
Antenna Gain	34 / 37 / 40 dBi	
Standard Compliance	EN 301 215-1 and EN 301 215-2, Type TS2	

BS Antennas

10.5 GHz 60 º Sector Vertical or Horizontal Antenna

The antenna is of the sector type covering an angular area. Up to eight sectors can be serviced by a single BS site using an RFU-antenna couple for each sector. Figure 5-1 and Figure 5-2 below show two views of a 10.5 GHz 60° Vertical or Horizontal sector antenna.

Figure 5-1: BS 10.5 GHz 60º V or H Sector Antenna (top)

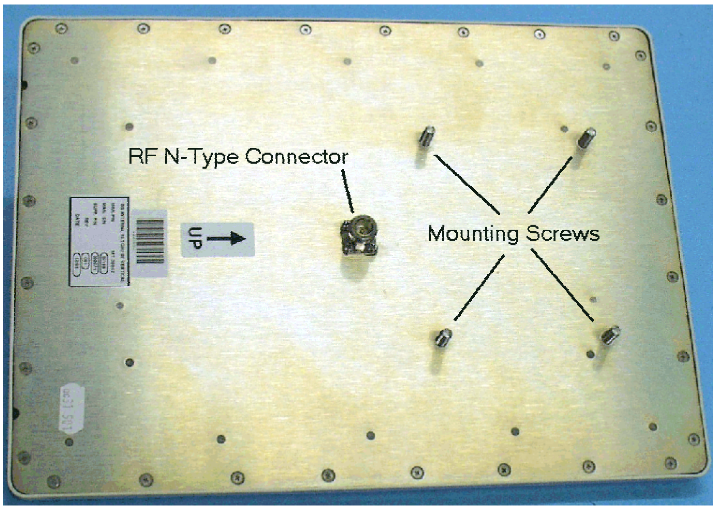

Figure 5-2: BS 10.5 GHz 60º V or H Antenna (bottom)- Vertical shown

10.5 GHz 90 º Sector Horizontal Antenna

The antenna is of the sector type covering an angular area. Up to eight sectors can be serviced by a single BS site using an RFU-antenna couple for each sector.

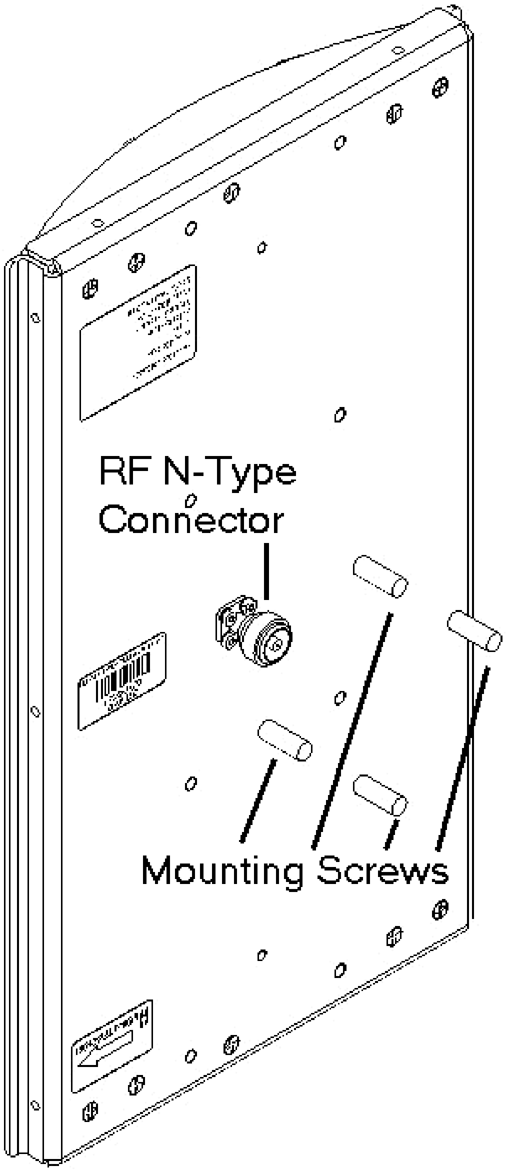

Figure 5-3. 10.5 GHz 90 º Sector Horizontal Antenna

10.5 GHz 90 º Sector Vertical Antenna

Figure 5-4 and Figure 5-5 below show two views of a 10.5 GHz 90º vertical sector antenna.

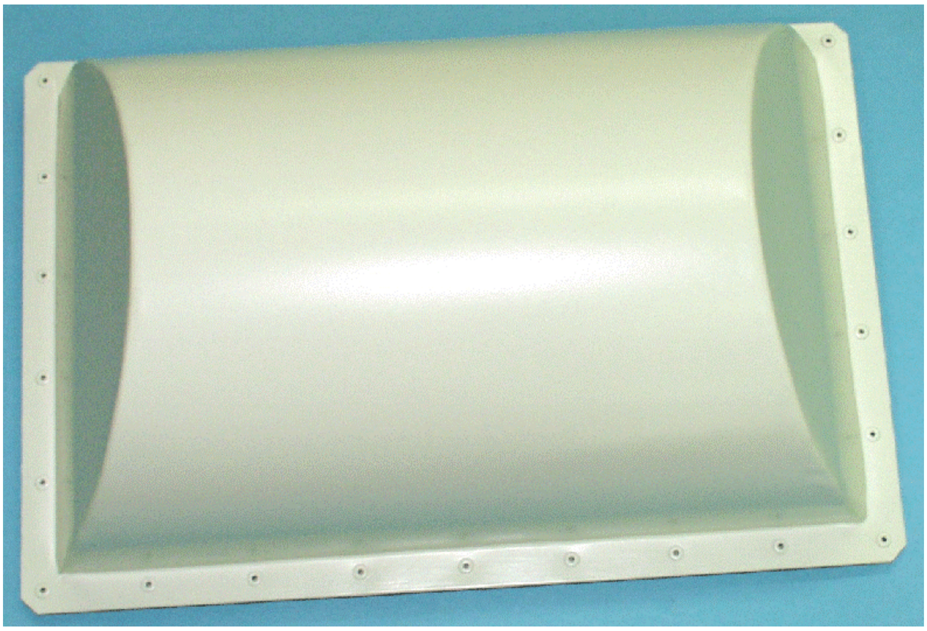

Figure 5-4: BS 10.5 GHz 90º Vertical Sector Antenna (top)

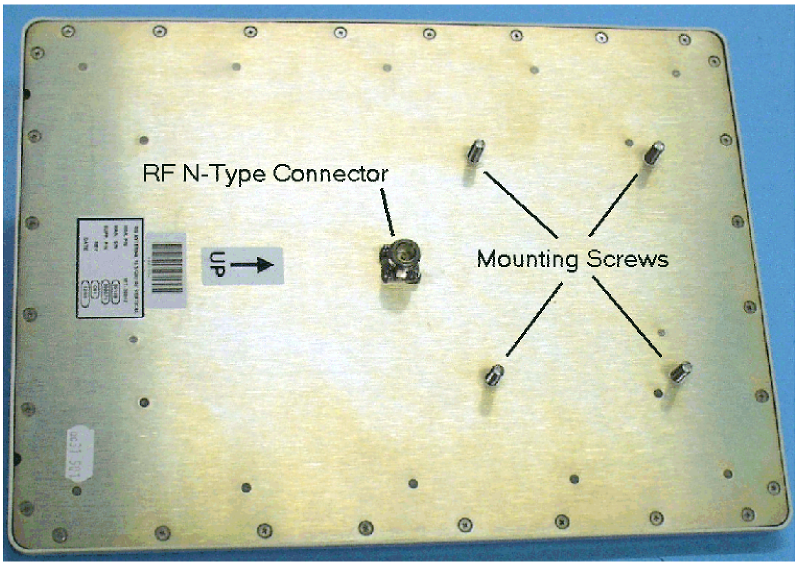

Figure 5-5: BS 10.5 GHz 90º Vertical Sector Antenna (bottom)

26 GHz Base Station Outdoor Unit

See also Base Station, on page 5-7, for Base Station specifications.

The BS 26 GHz ODU consists of the Radio Frequency Up/Down converter, to which a horn antenna is attached (see Figure 5-6).

NOTE: Two types of antennas are available: horn antenna and integrated. Note that the horn antenna protrudes more than the integrated antenna.

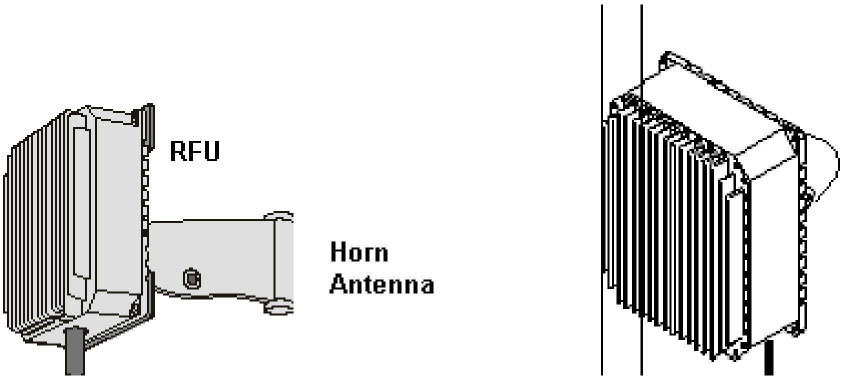

Figure 5-6: 26 GHz BS ODU with Horn antenna (left) and Integrated antenna (right)

28 GHz Base Station Outdoor Unit

See also Base Station, on page 5-7, for Base Station specifications.

Figure 5-8 shows side/bottom views of the 28 GHz Base Station ODU.

lists cables and connections.

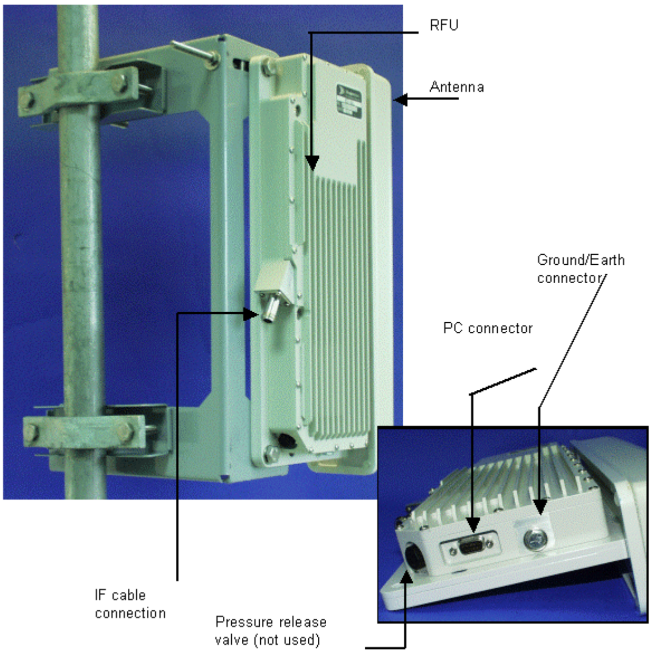

Figure 5-7: : BS 28 GHz ODU – Side and Bottom Views

Terminal Station Indoor Unit

Terminal Station Rear Panel

Figure 5-8: TS-BU Rear Panel (110/220 VAC option)

Figure 5-9: TS-BU Rear Panel (48 VDC option)

Table 5-12: Terminal Station LED Indicators

LED	Location	Function
PWR (Power)	Front Panel	Power indicator
ETH (Ethernet)	Front Panel	Ethernet (on-board) interface status
EXT (External)	Front Panel	Outdoor equipment status
INT (Internal)	Front Panel	Indoor equipment status
Telecom Interface (port)	Front Panel (1 per interface)	Interface status

NOTE: TS IDU Pin-outs are described in *WALKair3000 Installation, Appendix B*.

Terminal Station Outdoor Unit

The following outdoor units are described:

- 10.5 GHz Terminal Station Outdoor Unit
- 26 GHz Terminal Station Outdoor Unit
- 28 GHz Terminal Station Outdoor Unit

10.5 GHz Terminal Station Outdoor Unit

Figure 5-11 below shows a view of the 10.5 GHz Terminal Station Outdoor Unit.

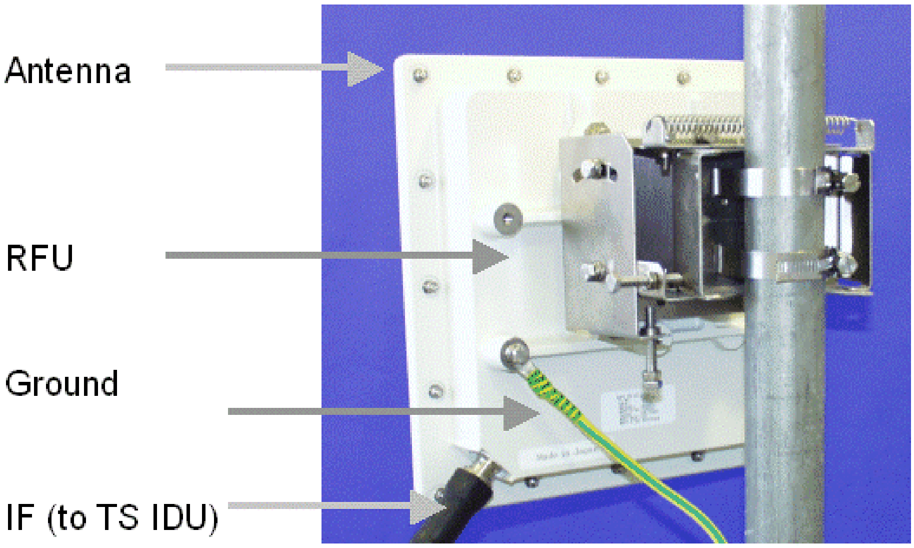

Figure 5-10: 10.5 GHz Terminal Station Outdoor Unit

26 GHz Terminal Station Outdoor Unit

See also Terminal Station, on page 5-13, for Terminal Station specifications.

The TS ODU is located on a pole, where it has a clear line of sight to the BS ODU associated with the respective sector. It consists of the Radio Frequency Up/Down-converter, to which a directional dish antenna is attached (see Figure 5-12).

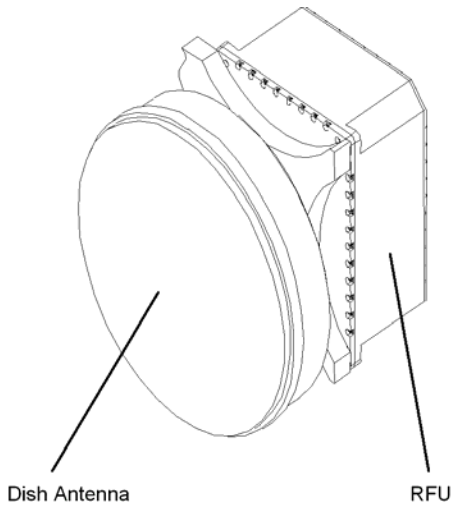

Figure 5-11: TS ODU General View

28 GHz Terminal Station Outdoor Unit

See also Terminal Station, on page 5-13, for Terminal Station specifications.

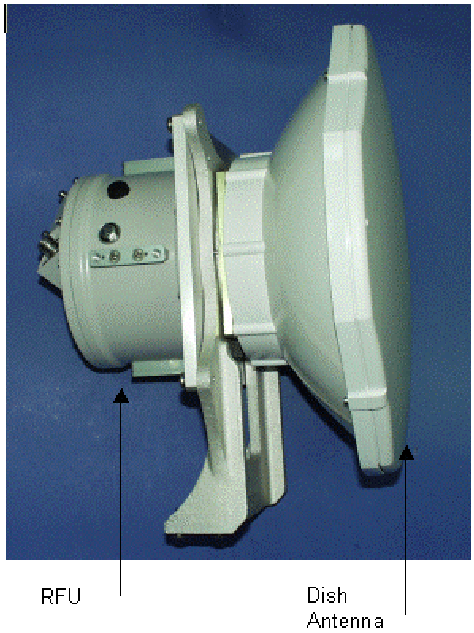

Figure 5-12: TS ODU 28 GHz – Side View

We're on your wavelength.

WALKair™ 3000

Installation Guide

About This Guide

The WALKair 3000 Installation Guide provides instructions for the personnel who are responsible for the correct installation of the WALKair 3000 Base Station and Terminal Station equipment.

The technical engineer should work according to the workflow presented in this guide (in Chapter 1 - Figure 1-2).

Please note that the the WALKair 3000 Site Survey Report is contained in Appendix A, and that the WALkair 3000 equipment pin-outs are listed in Appendix B.

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Contents

1

Chapter 1 - General Installation Instructions

In This Chapter:

This chapter includes the safety precautions and an overview of the installation procedure.

Safety and Environment Requirements

Environmental Requirements

The IDU complies with class 3.3 as per ETS 300 019-2-3.

The ODU complies with class 4.1E as per ETS 300 019-2-4.

Equipment Handling Cautions

CAUTION

Observe the following equipment handling cautions:

- Do not move or ship equipment unless it is properly packed in its original wrapping and shipping containers.
- Grounding brackets must always be worn when packing, unpacking, handling, extracting or inserting units carrying the EGB symbol to ensure that the units are not damaged.

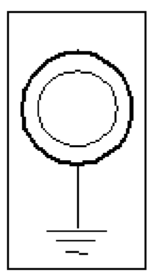

Figure 1-1: EGB Symbol

- Disconnecting the DC power supply cable, powers off the indoor units.
- Only WALKair 3000 trained personnel should undertake equipment service and maintenance or operate workstations used to communicate with the system.

Additional Safety Requirements

Pay attention to the following safety requirements before installing the WALK air 3000 equipment:

- The selected sites should be in a stable area free of access movement.
- Ensure that the cables and cords are out of the way.
- Ensure that the site is comfortable for the users.
- Locate the management or LCI device where it can be easily accessed and serviced (front and rear).

Power and Ground Connection Warnings

CAUTION

Observe the following power and ground connection warnings:

- Power for the rack-mounted system should come from a totally dedicated circuit breaker; do not plug any other electrical device into an outlet connected to the circuit breaker serving the rack equipment.
- All power branch circuits for the system must come from the same circuit breaker panel to avoid power flow in the data cables of the system.
- Check the manual rating of all system units and verify that the sum of the ampere ratings do not exceed two thirds of the branch rating.
- All branch circuits must have a "third wire" type ground for the branch circuit that only goes to the circuit breaker panel. Conduit ground is unacceptable for any portion of the system.
- DC cable shield must be connected to ground on both sides. Provide a secure connection to the unit ground pin.
- Make sure that the circuit breakers furnishing power to the system are the correct size to protect the system.
- Make sure that all receptacles are wired for three-wire power distribution (line, neutral and ground).
- All power receptacles servicing any equipment directly connected to the system must have a single, common grounding point.
- The ground wire must be at true ground potential with a resistance (measured at the power panel bus) of 5Ω or less between the bus bar and earth.
- Place the equipment within six feet of the electric receptacle and do not use extension cords.

- When connecting equipment to the DC voltage supplies, ensure correct polarity.
- When disconnecting the DC power supply cable from the main distribution power, first disconnect the +/- 48V supply and then disconnect the ground.

General Safety Summary

CAUTION

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment.

Failure to comply with these precautions or with specific warnings elsewhere in this manual could result in personal injury or damage to the equipment.

The safety precautions listed below represent warnings of certain dangers of which Alvarion is aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

Grounding the Equipment

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical earth ground. If the equipment is supplied with a three-conductor AC power cable, the power cable must be plugged into an approved three-contact electrical outlet, with the grounding wire (green/yellow) reliably connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable must meet International Electro technical Commission (IEC) safety standards and local electrical regulatory codes.

Fire Precautions

Do not operate the equipment in any explosive atmosphere such as in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment could result in an explosion and cause injury or damage.

Servicing the Equipment

Operating personnel must not remove equipment covers. Only Factory Authorized Service Personnel or other qualified service personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment. Service personnel should not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, such personnel should always disconnect power and discharge circuits before touching components.

Substituting Parts or Modifying Equipment

Do not install substitute parts or perform any unauthorized modification of the equipment. Contact your local Alvarion representative for service and repair to ensure that safety features are maintained.

Installation Process Overview

Figure 1-2 illustrates the installation process workflow.

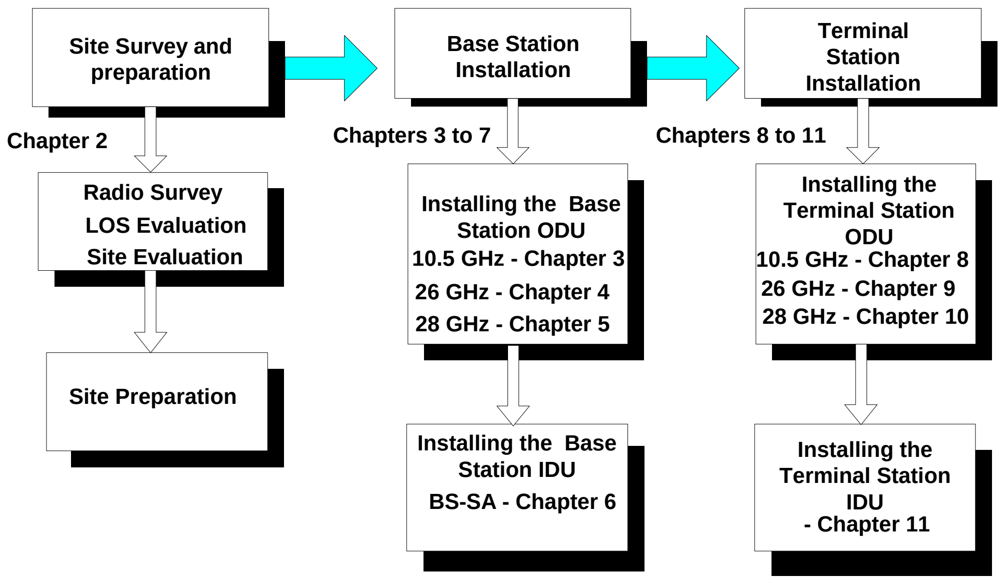

Figure 1-2: Installation Process Workflow

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2

Chapter 2 - Site Survey and Preparation

In This Chapter:

This chapter provides a description of the site IF and RF surveys and preparation.

Site Survey

The objectives of the site survey are as follows:

- Provide general site data for site engineering
- Map the radio interference located at the site
- Validate the Line-Of-Site (LOS) conditions
- Validate the basic environmental conditions for the proper function of the WALKair 3000 system

Radio Survey

Required Equipment

The equipment required for the radio survey is detailed in Table 2-1.

Table 2-1: Radio Survey Equipment

Component	Requirement / Type	Function
Band-Pass Filter	10.5/26/28 GHz band; low noise	Prevents the RF Amplifier from generating inter-modulation.
RF Amplifier	Gain: 30dB or 40dB minimum; Noise Figure: 4dB maximum	Increases the sensitivity of the spectrum analyzer.
Power Cable		Supplies DC voltage to the RF Amplifier.
Power Supply		Supply DC power to the RF amplifier
Spectrum Analyzer	Up to 29 GHz band	Measures the frequency response
Antenna	45° BS antenna for 10.5/26/28 GHz	
Plotter		Records the measurement results.

Setup

NOTE: Where an RF survey is impractical, due to equipment unavailability or other reasons, an IF survey can be performed. The IF survey is performed after the installation. See IF Survey on page 2-4.

Figure 2-1 shows the test setup for detecting radio frequency interference. Due to poor sensitivity, the spectrum analyzer is connected to the antenna through a bandpass filter and a low noise RF amplifier.

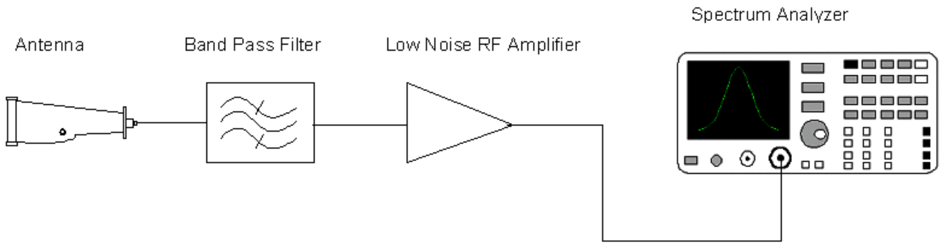


Figure 2-1: Radio Survey Setup

RF Survey Procedure

To perform an RF Survey

1. When positioning antennas at the BS and TS sites:
   - A 360° coverage area is required for a BS antenna.
   - A 180° coverage area is required for the TS antenna.
   - First capture the proposed operating area of the antenna, and then rotate the antenna through the required 360°.
   - The polarization of the survey antenna must be the same as the planned polarization.
2. When operating the spectrum analyzer:
   - Calibrate the spectrum analyzer before use.
   - Use the **Max Hold** feature to provide full coverage.
   - Two images are required for every angle, one with a maximum resolution bandwidth (RBW) of 2MHz and the other with a minimum RBW of 1 KHz.
   - The sweep time should be 50 ms maximum.
   - The video bandwidth (VBW) of the spectrum should be set to RBW.
   - Each image must be measured for at least 5 minutes.
3. When performing the measurement:

- The observation span of the uplink band will be carried out at the BS site and the observation span of the downlink band at the TS site.
- Check for additional interference by changing the polarization of the antenna and the RBW.
- Frequency band response of the RF amplifier must be set to 10.5 GHz, 26 GHz or 28 GHz according to the system.
- The noise level of the spectrum should increase after supplying DC to the amplifier.

IF Survey

If conditions are unsuitable for an RF survey, it is recommended to perform an IF survey according to the instructions in this section. The IF survey is performed following the installation.

Required Equipment

The following equipment is required for the IF survey is detailed in the following table.

Table 2-2: IF Survey Equipment:

Component	Requirement/Type	Function
Spectrum Analyzer	Up to 29 GHz band	Measures the frequency response
Signal Cable Splitter (Order a IF-MUX II from Alvarion)	Up to 29 GHz band	Mux/Demux of IF signal and DC power feed to RFU.

Setup

Figure 2-2 shows an IF Survey Setup, for a Base Station on the left, and a Terminal Station on the right. The IF Survey must be performed for Base Stations and for Terminal Stations.

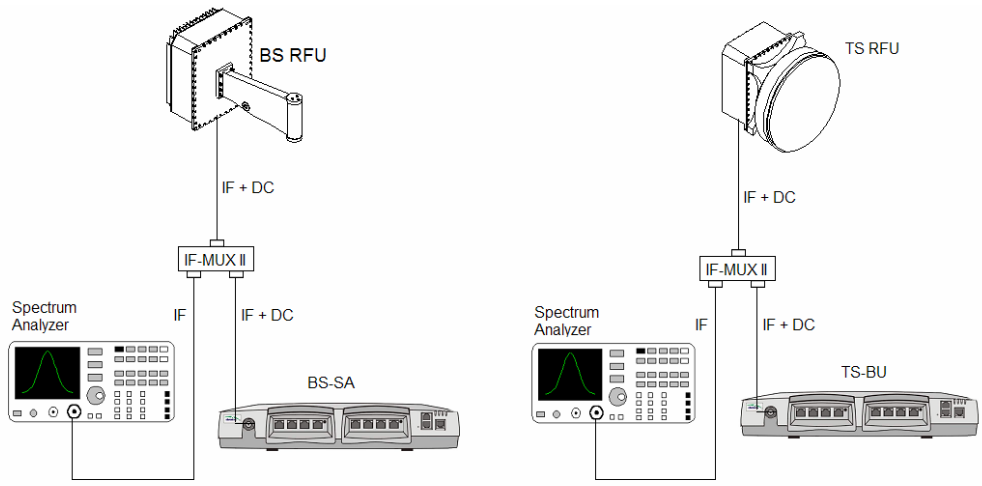


Figure 2-2: IF Survey Setup

IF Survey Procedure

The IF survey is performed and normalized to provide an RF Signal result, using the following equation:
RF Signal = IF Signal – [IF Cable and MUX attenuation] + RFU Gain

To perform an IF Survey:

1. Set up the equipment as illustrated in Figure 2-2.
   - The IF-MUX II cables and the RFU cable ends are connected using an N-Type female connector.
   - Ensure that the *DC* output of the IF-MUX II is attached to the BS-SA/Terminal Station and not to the Spectrum Analyzer.
2. Measure the IF signal and record it.

NOTE: For low power interference, the signal may not be clearly visible because noise added by the receiver reduces the signal to below the spectrum analyzer noise floor.

3. IF Attenuation over the IF Cable and IF-MUX II must be measured and recorded.
   - **For a Base Station with configured IF-MUX II**– via the BS-SA LCI interface, obtain the combined IF Cable and IF MUX attenuation value as follows:

a. From the **LCI Main menu**, select option **1**- **Configuration** menu, and then choose option **4 Sector Configuration Parameters** menu. The Sector Configuration screen appears.

```
Sector Configuration Menu
----------------------------
1. Set Sector Parameters.
2. Get Sector Parameters.
```

b. Select option **2** – **Get Sector Parameters** to view the current configuration and cable gains in the Tx and Rx path.

```
MPU/L/A> Enter Option No :

2

        Mux Type : 2 Port Mux
        TX Value is 15.00000
        Mux Rfu Redundancy is disabled
        MUX (Rx) & cable Gain is -5.000000.
        MUX (Tx) & cable Gain is -6.000000.
MPU/L/A> Enter Option No :
```

- **For a Base Station in which IF-MUX II is not yet configured:**
  - IF MUX attenuation = –4 dB (by default)
  - IF Cable attenuation = obtain from its data sheet.
  - Combine the two values to obtain the total IF Cable and IF-MUX II attenuation value.

NOTE: The above procedure for a Base Station must be performed after the RFU and antenna parameters are configured. Otherwise, the IF-MUX II attenuation will retain its default value *of* ***-4****.*
See also the *WALKair 3000 Commissioning Guide, Chapter 2*.

- **For a Terminal Station**, the IF-MUX II attenuation is –4 dB, and the IF Cable attenuation can be obtained from its data sheet. Combine the two values to obtain the total IF Cable and MUX attenuation value.

4. Note down the Base Station RF Gain as follows:
   - For a 26 GHz BS: 40 dB
   - For a 28 GHz BS: the configured gain
   - For a 10 GHz BS, 40 dB
5. Note down the Terminal Station RF Gain as follows:
   - For a 26 GHz TS: 40 dB
   - For a 28 GHz TS: the configured gain

- For a 26 GHz (short range) TS: 23 dB.
- For a 10GHz (short range) TS: 40 dB

6. Normalize to calculate the RF Signal as follows:

   RF Signal = IF Signal – [Cable and MUX attenuation] + RFU Gain

LOS Evaluations

This section describes the recommended methods for achieving a full line of sight (LOS) and addresses LOS problems that may arise when selecting sites for the WALKair 3000 system installation.

Generally, large reflecting surfaces in parallel or partly in the beam, like Metal or glass buildings, moist earth, water and above ground metals (poles and telephone lines), will cause reflections of the radio signal.

If you have a clear line-of-sight, the effect of this interference will be minor.

NOTE: Avoid installing the ODUs near reflecting objects.

Two topologies are covered:

- TS sites visible from the BS site
- TS sites not visible from the BS site

Terminal Stations Visible from Base Stations

To estimate LOS:

1. Use one of two methods to find the WALKair 3000 LOS:

   a. Use a software tool for verifying there are no obstacles within the first-order Fresnel Zone in the selected frequency band between the BS site and the TS site. This tool utilizes a pre-entered terrain map and 3D calculations.

   b. Visually identifying a possible obstruction in the LOS, and then determining the distance between the BS site and the obstruction and then the TS site and the obstruction. There are two ways in which these distances can be determined:

   - Using a GPS receiver.
   - Using a map.

2. Obtain the first-order Fresnel Zone radius using Fresnel Zone table
3. Roughly estimated the distance between the visibility line and the obstruction.

Imagine an obstruction in the form of the building shown in Figure 2-3. From the TS site antenna, the **distance seen** between the obstruction and the **visibility line** (the center of the BS site antenna) is as high (or as wide) as one storey. For a 2.5m high storey, the distance between the visibility line and the building is approximately 2.5 m.

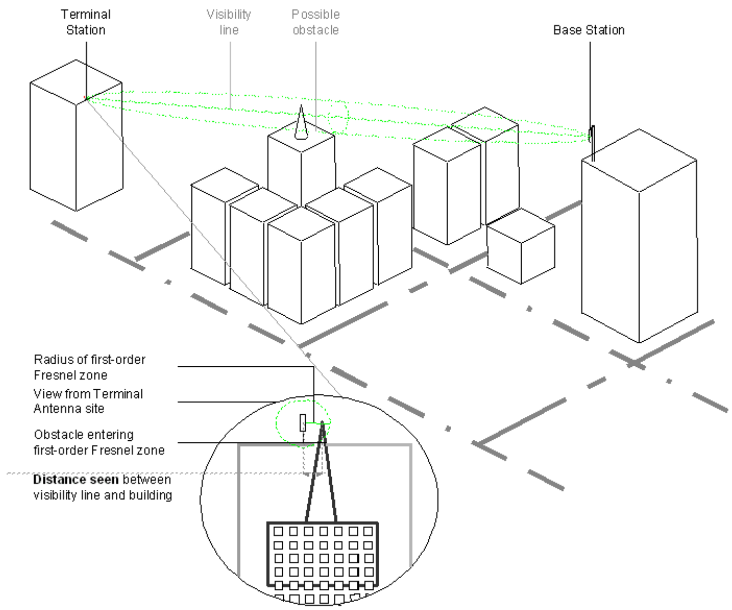


Figure 2-3: Fresnel Zone Violation

Terminal Stations not Visible from Base Station

For WALKair 3000 links that are longer than 3.5 km, it is not possible to estimate the distance between the visibility line and an obstruction since the TS site is not visible from the BS site.

To find the WALKair 3000 LOS:

1. Use one of two methods to find the WALKair 3000 LOS:
    - Using the software tool described in the previous section
    - Measuring the height of a potential obstruction using an altitude meter
2. Draw the BS and TS sites on a map and find the azimuth between them as shown in Figure 2-4.

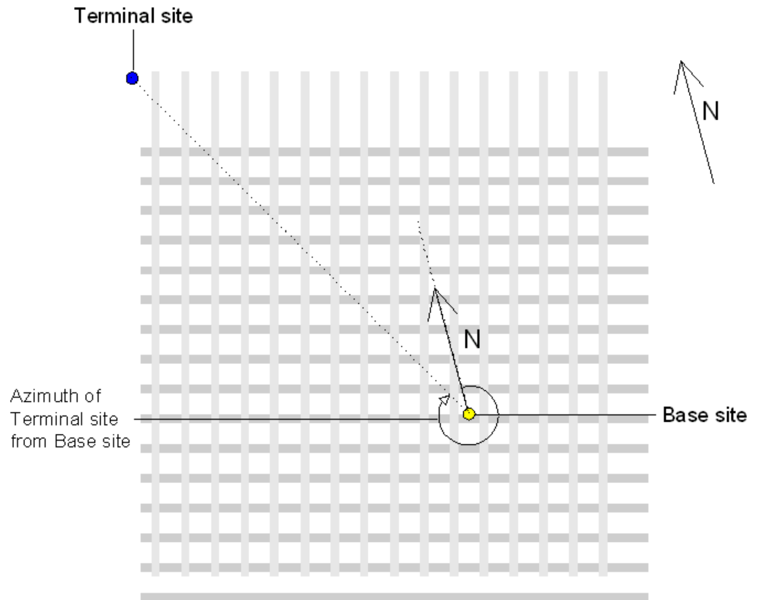


Figure 2-4: Measuring Azimuth between the BS and TS Using a Map

3. Observe the TS site using a compass and binoculars. A possible obstruction may be identified at this stage as shown in Figure 2-5.

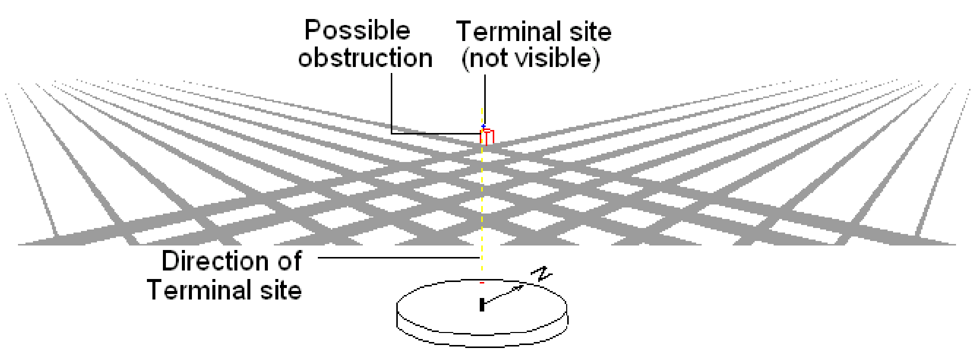


Figure 2-5: View from the BS Site

4. Next, the distances between the obstacle, Terminal site and Base site are measured using either a map or a GPS receiver.

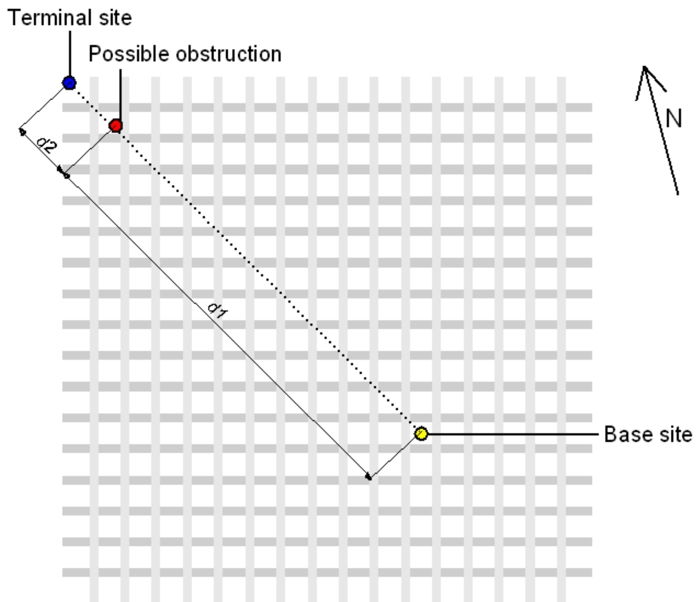


Figure 2-6: Measuring Distances Using a Map

5. Calculate the radius of the first-order Fresnel Zone (*rF*) using the measured distances between the obstacle and the TS and BS (*d1* and *d2*) and the Fresnel table.

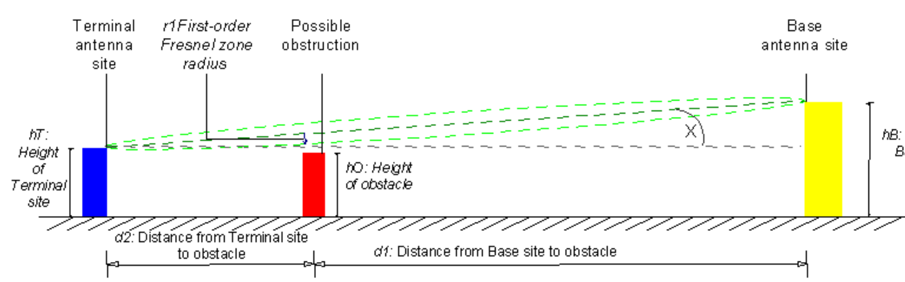


Figure 2-7: Altitude Measurement

6. Verify that the highest obstruction does not enter the first-order Fresnel Zone as shown in Figure 2-7 using either a GPS receiver or an altimeter.

7. After the values of h_O, h_B and h_T are determined, use the following formula in order to find the maximal height of the obstruction:

$$\tan x = (h_B - h_T)/(d_1 + d_2))$$

$$h_M = h_T + d_2 \times \tan x - r_F \times \cos x$$

NOTE: A worst-case design should be applied to the measurement tolerance when entering the parameters into the formula.

- h_M is the maximal allowed height of the obstruction.
- h_B is the BS antenna height above the sea level.
- h_T is the TS antenna height above the sea level.
- r_F is the radius of the first-order Fresnel Zone.
- Finally, compare h_M to the obstruction's height.

Example of a Maximal Obstruction Height

The distance between the Base site and the Terminal site is 4 km. The obstruction is 300 m from the Terminal site, and the band is 26 GHz. The height of the Base site is 150 m (measured), the height of the Terminal site is 60 m (measured) and the height of the obstruction is 55 m (measured). The radius of the first-order Fresnel Zone is 4 m (calculated). The tolerance of the altitude measurement is 2 m.

$$d_1 = 3700m$$
$$d_2 = 300m$$
$$r_F = 4m$$
$$h_B = h_B - Tolerance = 148m$$
$$h_T = h_T + Tolerance = 62m$$
$$h_O = h_O + Tolerance = 57m$$
$$\tan x = (148 - 62) \div (3700 + 300) = 0.0215$$
$$\cos x = 0.99$$
$$h_M = 60 + 300 \times 0.0215 - 4 \times 0.99 = 62.45m$$

Where:

- hM is the maximal allowed height of obstruction.
- h_B is the Base antenna height above sea level.
- h_T is the Terminal antenna height above sea level.
- h_O is the obstruction's height above sea level.

Then $h_M \rangle h_O$ and the conclusion is that the obstruction does not enter the first-order Fresnel Zone, and does not interfere with the LOS.

Site Preparation

This section provides a description of the site preparation requirements before the installation of the WALKair 3000 system. This includes:

- Antenna mast installation and grounding
- IF cable deployment and connector assembly
- Rack preparations before installations
- Power supply installation and power cable deployment

Antenna Mast

This section describes the pre-installation requirements and stability specifications for the antenna mast.

Pre-installation Requirements :

Verify the following before installing the mast:

- That the location of the mast is according to the site plan, as specified by the site survey report.
- That the mast is properly grounded
- That there is lightning protection prior to installation of the RFU
- That there is a safe access to the mast, free of any obstacles or other dangers for installers of the RFU
- That there are no power lines near the mast
- That the antenna positioned on the pole cannot be crossed by anybody walking on the roof

Mechanical Stability of the Pole

The following table lists the pole stability required in the installation point for all types of antennas.

NOTE: For **26/28 GHz** bands, the pole tilt angle should not exceed ± 15% of the minimal beam width of the installed antenna.

Table 2-3: Pole Stability

Band	BS	TS
26/28GHz	+1.0°	+0.4°
10.5GHz	+1.4°	+1.2°

The following table lists the pole diameter requirements for all bands (Base and Terminal):

Table 2-4: Pole Diameter Requirements

Band	BS	TS
10.5 GHz	2"-4"	2"-4"
26 GHz	2"-4"	2"-4"
28 GHz	2"-4"	2"-4"

IF Cable Installation

General

Use a single coaxial cable between the IDU and each RFU unit.

For the BS site, the number of IF cables equals the number of sectors into which the BS cell is divided, whereas for the TS site, a single IF Cable is required.

NOTE: For redundancy installations, two IF cables should be installed for each sector – one for each RFU.

On the ODU side, the IF cable is connected directly to the RFU IF connector at both BS and TS sites. At the BS IDU and TS IDU installations, the IF cable is directly connected to the N-type IF connector, which is mounted on the IDU front panel.

IF Cable Characteristics

The IF cable characteristics should match the parameters listed in the following table.

Table 2-5: IF Cable Requirements	
Parameter	**Details**
Operating Temperature	-40°/+85°
Weatherproof	UV, waterproof
Frequency Range	600MHz – 2000MHz
Impedance	50Ω
Attenuation *1	
For 26GHz/28GHz Tx (1600-1800) MHz Rx (600-800 MHz)	 2dB to 20 dB 1 dB to 12dB
For 10.5GHz	
Tx (1000-1150) MHz	2dB to 20 dB
Rx (650-800 MHz)	1 dB to 12dB
Interface	N-Type: male
Diameter	3/8" maximum (recommended)
*1 The attenuation includes 1dB for the attenuation of the connector assemblies on both sides.	

Example of Recommended IF Cable

Example of the recommended IF cable type and interface are as follows:

- **IF cable type:** One example of an LMR-400 standard outdoor cable is manufactured by Times Microwave Systems. This cable is characterized by its low loss as shown in Table 2-6, which permits a long distance between the ODU and IDU. For further details, see http://www.timesmicrowave.com/.
- **Interface:** N-male, straight interface plug, part number TC-400NM and crimp attachment.

Table 2-6: Times Microwave Systems' LMR-400 Cable Attenuation			
Frequency	**Attenuation**		**Average Power**
MHz	dB/100ft	dB/100m	KW
450 MHz	2.7	8.9	0.83
900 MHz	3.9	12.8	0.58
1500 MHz	5.1	16.8	0.44
1800 MHz	5.7	18.6	0.40
2000 MHz	6.0	19.6	0.37

NOTES:

- When routing the coaxial cable, leave a service loop at the RFU to ensure sufficient length of coaxial cable for replacing a faulty connector, when necessary.
- Secure the coaxial cable preventing mechanical stress at the RFU connection. Run the coaxial cable to the IDU IF connection.
- If the coaxial cable requires suspension from the RFU to the building, use a stranded wire to support the coaxial cable weight (the support will prevent a migration of the coaxial cable's inner conductor to the shield).

Tools for Crimp Connector

Assemble the cable connectors for LMR-400. Use the tools listed in Table 2-7 for the crimp connector.

Table 2-7: Required Tools for Crimp Connector (LMR-400)		
Tool Type	**Part Number**	**Description**
Crimp tool	HX-4	Crimp handle
Deburr tool	DBT-01	For "EZ" style connectors
Strip tool	ST-400EZ	For crimp connectors
Ground kit	GT-S400T	Grounding kit

NOTES: The N-type connectors of the ODU and IDU must be closed by hand without using any tool. The outdoor connectors should be tightened using sleeves

Short Circuit Test

A short circuit test must be performed on the IF cable connectors prior to the sealing and connection of the equipment. Perform a short test for the cable as shown in Figure 2-8

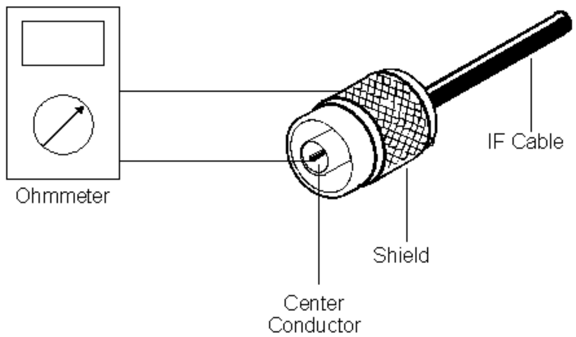


Figure 2-8: IF Cable Testing

Labeling IF Connector

Label the IF connector as follows:

- Label both sides of the IF cable with a non-removable label.
- The label must include the cable length attenuation and RFU head details: sector direction, etc.

Sealing ODU Connectors

It is recommended to seal the ODU connectors using the 3M's cold shrink tube 8426-9 (recommended), which requires no training or special tools.

If you are using the 8426-9 cold shrink, leave a 10 cm space as shown in Figure 2-9 to keep the cable flexible.

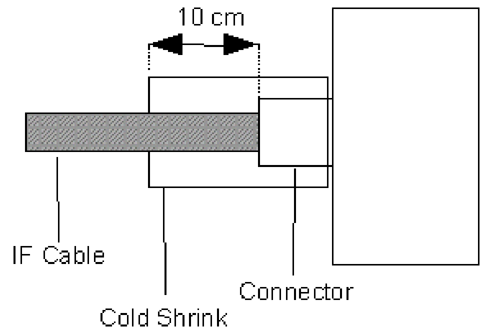


Figure 2-9: Sealing ODU Connectors

NOTES:

- The N-type connectors of the ODU and IDU must be closed by hand without using any tool.
- The outdoor connectors should be tightened using sleeves

Rack Preparation

This section describes how to prepare the rack as part of the site preparation process.

Pre-installation Requirements

Before installation of IDU, verify the following:

- Rack overview.
- Placement of the rack based on the proposed BU location.
- Preparation of the required screws
- Grounding point location of each rack
- Cable ducting for the following:
  - IF cable
  - Power cable
  - Telecom cables
- Patch panel for rack power or telecom interface connections as determined by rack equipment planning.
- Ventilation
- Power supply.

Base Station Rack Installation Considerations

The BS-SA unit is designed for installation in an ETSI or 19" wide rack, on a wall, or on the desktop.

Locate the BS-SA unit so it can be easily accessed and serviced.

Consider the following when planning the location of the equipment in the rack:

- In heterogeneous racks (rack collocation of the WALKair 3000 and some other rack equipment), mount the heaviest units near the bottom of the rack.
- Plan the rack space according to the hardware requirements.
- Allow for 1U between the BS-SA units in the rack.

Terminal Station Rack Installation Considerations

The TS IDU is designed for installation in an ETSI or 19" wide rack, on a wall, or on the desktop. For the TS IDU, check that the following requirements are met:

- Locate the TS IDU so it can be easily accessed and serviced, where the traffic connections are on the front panel and the power connections and fuse – on the rear.
- When AC powered, place the TS IDU within a distance of 3m from the AC main outlet.

Rack Grounding of WALKair Equipment

All WALKair equipment installed in racks (BS-SA, BS-BU, TS-BU and IF-MUX) must be grounded to the rack:

- Each unit has a grounding pin located on its rear panel.
- Connect one end of the grounding cable to the grounding pin, and connect the opposite end of the cable to a central ground point on the rack.
- The rack must then be connected to the ground of the room or building.
- After grounding, you must then verify or test the ground in accordance with local standards.

Power Distribution and Characteristics

Power Characteristics

The power requirements of the IDU are described in the following table.

NOTE: IF-MUX II units receives power from the corresponding BS-SAs.

Table 2-8: WALKair Power Requirements				
Unit	**Operational Conditions**	**Typical Power (Watts)**	**In rush current**	**Max. Power (Watts)**
BS-SA	-48 VDC @ 25°C with RFU	62	50 A for 60µs	120
IF-MUX 4	-48 VDC @ 25°C with RFU	90		120
E1 switch	-48 VDC @ 25°C	72		
TS IDU	220 VAC with RFU	47	12 A for 5µs	55
Power Feeder	-48 VDC @ 25°C	43/RFU	2 A for 10µs/per RFU	48/RFU

Guidelines for Power Distribution and Grounding Lines

When preparing power and grounding cables, pay attention to the following guidelines:

- Do not plug any other electrical device into an outlet connected to the circuit breaker serving the TS or BS equipment.
- All power branch circuits (BS-IDU, IF-MUX 4, etc.) for the system must come from the same circuit breaker panel to avoid power flow in the data cables of the system.
- DC cable shield must be connected to ground on both sides. Provide a secure connection to the unit (BS-SA, IF-MUX 4, E1 Switch or Power Feeder, and TS) ground screw.
- The BS IDU earth stub must be connected to the rack ground.
- All power receptacles servicing any equipment directly connected to the system must have a single, common grounding point.

Cable Preparation

Four types of cables are required for both BS and TS WALKair 3000 installations:

- Power and grounding cables
- Management connections
- Traffic cables (E1 and Ethernet cables)
- IF cable

When preparing cables, observe the following general guidelines:

- AC/DC Power, traffic, IF and management cables should be prepared on-site.
- Do not expose cables to moisture or heat.

Preparing the Power and Grounding Cables

Power for the system must come from a totally dedicated circuit breaker. Table 2-10 and Table 2-11 provide details of the required power and grounding cables for a typical WALKair 3000 installation.

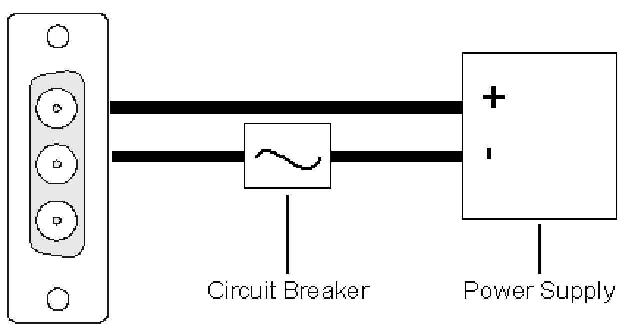
Table 2-9: BS Power and Grounding Cables Data

Function	From	To	Cable Type /Connector		Qty Unit	
BS-SA Power Feeder ground	Rack grounding	Unit ground screw	4AWG	-	1	
BS-SA Power connections	PS	Unit power (rear)	16-18 AWG**	2-pin		
IF MUX 4/E1 Switch/Power Feeder –48V	Rack power panel	Unit power plug (rear)	18 AWG	3-pin D-type	1 to 8	*1
*1	The number of cables is the number of IF MUX units/Power Feeders ** Wire insulation, Diameter 1.8-3.1mm.(0.071-0.122")					

Table 2-10: TS Power and Grounding Cables Data					
Function	**From**	**To**	**Cable Type and Connector**		**Qty per Unit**
TS IDU ground	Rack grounding	Unit ground screw	4AWG	-	1
TS IDU power	Main power outlet	Unit power plug	Per site AC installation		1

IF MUX 4, E1 Switch, Power Feeder Cord Pin Out

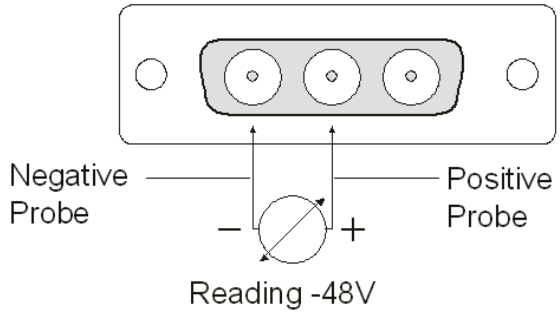
An 18-gauge cable is recommended for the -48V power supply cable. Connect the power cord of the device, as illustrated in the following figure.



1. Figure 2-10: Connecting the Power Cord

Before testing, verify that the red probe (+) is connected to the red socket on the test meter. Test as follows:

1. Insert the plus probe into the center connection point.
2. Insert the minus probe into left connection point. Observed meter readings should not be lower than -48V.



2. *Figure 2-11: Test Meter*

Preparing the Traffic Cables

When preparing traffic cables, observe the following guidelines:

- Do not run traffic cables parallel to AC power cables within less than 10cm of each other.
- Do not install traffic cables close to electric motors, power line regulators, relays or power supplies.
- Avoid laying traffic cables close to air conditioners, copy machines, water coolers and other equipment that generates power line “noise”.
- Do not run traffic cables near equipment that generates radio frequency interference (for example, radio transmitters).

Table 2-12 and Table 2-13 supply the details of the applicable traffic cables.

Table 2-11: BS Traffic Cables Data

Function	From	To	Cable Type and Termination		Qty per Unit
Ethernet	BS-SA Front	DDF	CAT 5	RJ-45	1
E1	BS-SA Front	DDF	RJ-45 (120 Ω)	RJ-45	0 to 8

Location of Traffic Cables

When choosing the physical location of the WALKair 3000 equipment, pay attention to the location of the traffic frames and to the traffic cables' running path.

Watch the following guidelines:

- Do not install traffic cables close to electric motors, power line regulators, relays, or power supplies.
- Avoid laying traffic cables close to air conditioners, copy machines, water coolers, and other similar equipment that generates power line "noise".

Table 2-12: TS Traffic Cables

Function	From	To	Cable Type and Connector		Qty per Unit
Ethernet	TS IDU front	DDF/ Switchboard	CAT 5	RJ-45	2
E1	TS IDU front	MDF	RJ-45 cable	RJ-45	0-8

3

Chapter 3 - 10.5 GHz Base Station ODU Installation

In This Chapter:

This chapter describes the 10.5 GHz Base Station RFU and antenna installations.

General Guidelines

When installing the Base ODU, the following steps must be performed:

- Install the outdoor equipment, including the antenna.
- Connect RF and IF cables.
- Align the Base antenna (as described in the following section)
- Mount the unit.
- Ground the ODU.

Follow the guidelines below to ensure proper and smooth installation.

NOTE: Perform an RF survey at the beginning of an installation project to ensure that the spectrum is clear. Continue performing surveys every so often during the course of installation to ensure that no one is interfering with your spectrum.

Location and Orientation

- **Location:** the location of the RFU on the mast, the location and orientation (azimuth) of the antenna, including tilt when applicable, must be determined prior to installation.
- **Do not install the antenna at the top of the pole:** Always leave at least 40 cm space between the top of the pole and the antenna for better lightning protection.
- **The RFU must always be installed at the rear side of the antenna** in order to prevent self-reflections.

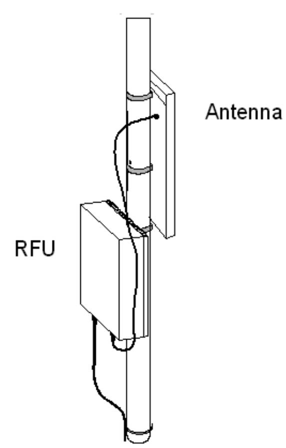


Figure 3-1: RFU Installation

Clearance around BS Antennas

- To avoid frequency reuse problems caused by unwanted reflections, the main lobe of the antenna must be clear of any metallic objects for a range of up to 20 meters.
- In order to avoid the need to refer to particular antenna radiation patterns, the following criterion can be used: Clear metallic objects from a zone of up to 90 degrees to the right and left, and 45 degrees above and below, the antenna bore sight, for a distance of at least 20 meters, as shown below:

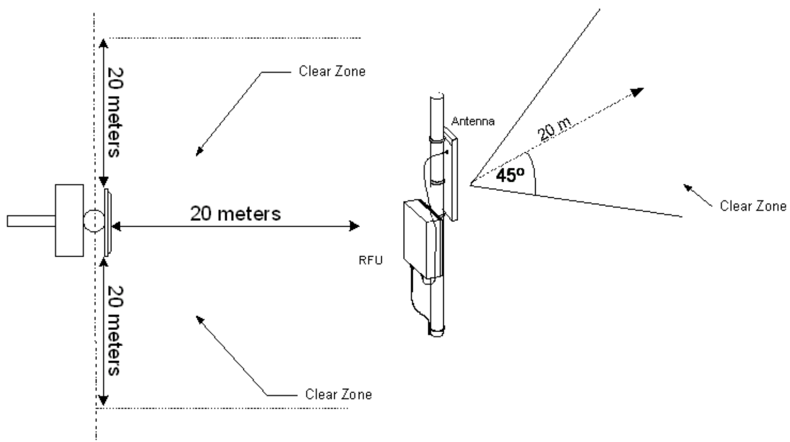


Figure 3-1: RFU Installation: BS Antenna Clearance

- Make sure that there are no obstacles located in front of the WALKair antenna, such as masts, transmission equipment from other vendors, or another WALKair antenna. These kinds of obstacles can reflect power from the rear Terminals (which are behind the antenna) directly into the antenna's main beam, which can potentially decrease the Frequency Reuse performance.

Alignment

- **BS Antenna Alignment:** Proper alignment of the base antenna in the elevation plane is critical for decreasing the level of interference with neighboring cells. Therefore, be sure to balance the antenna pole before Elevation alignment. We recommend using an electronic level for proper pole balancing.

Inter-sector Distance

- **Inter-sector distance;** The minimal distance required between neighboring sectors is 1m, as shown below:

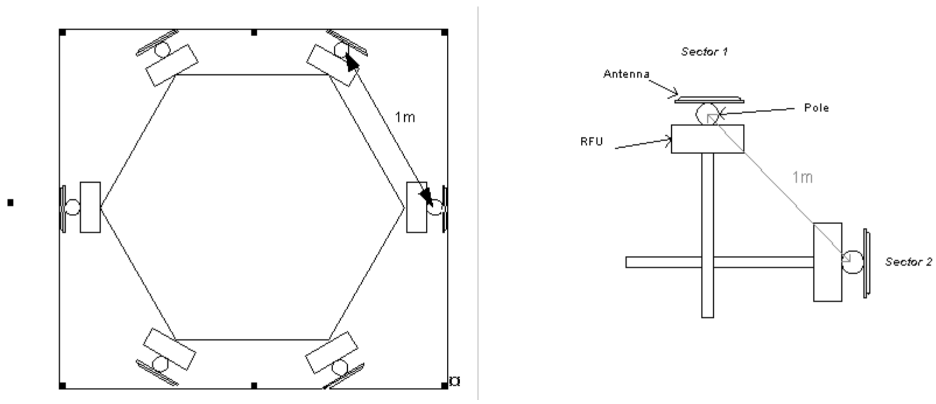


Figure 3-2: Distance Between Neighboring Sectors

Roof Corner Installation

When installing on a roof corner, leave a space of 0.5m above the railing and no less than 15m above the ground, as shown below:

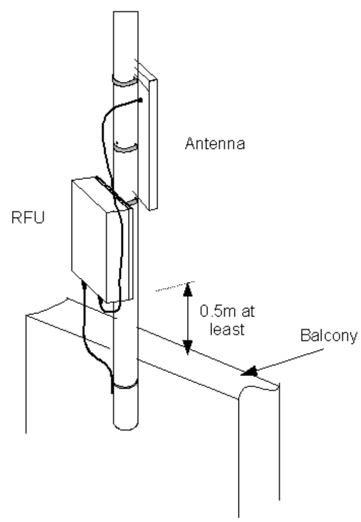


Figure 3-3: Installing on a Roof Corner

Redundancy Installations

For redundancy installation, you can use two kinds of setups, as shown below.

NOTE: Before tightening the redundant antenna, verify that the alignment is the same as the original sector.

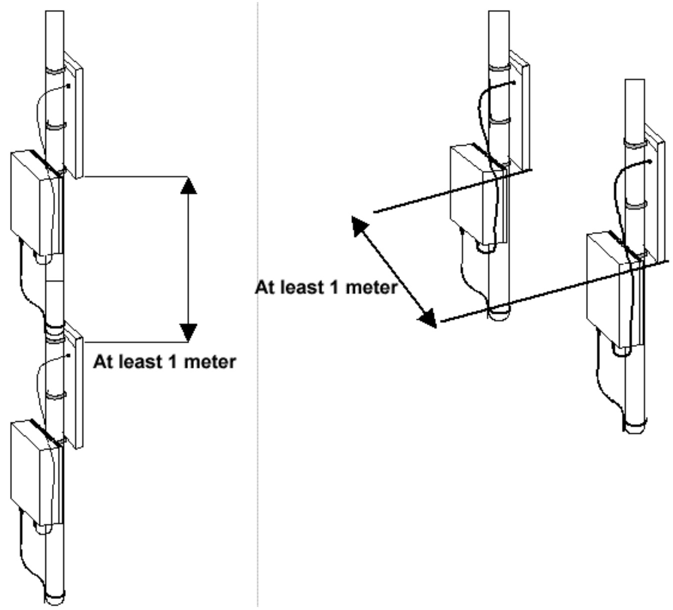


Figure 3-4: Redundancy Installation

Inspection

- Before leaving the installation site, check that all the hardware on the mount and antenna is secure.
- The antenna should be inspected at least once a year to check its condition and to ensure safe operation and maintenance. Qualified personnel, experienced in antenna installation, must perform this inspection.

RFU Views and Specifications

The following table shows the physical specifications of the 10.5 GHz BS RFU.

Table 3-1: 10.5 GHz Base Station RFU Unit Dimensions

RFU Rev	Size (mm)	Weight (kg.)
C	3325x270x156	10.1 (including mounting kit)

Figure 3-14 shows two views of the NJRC 10.5 GHz RFU.

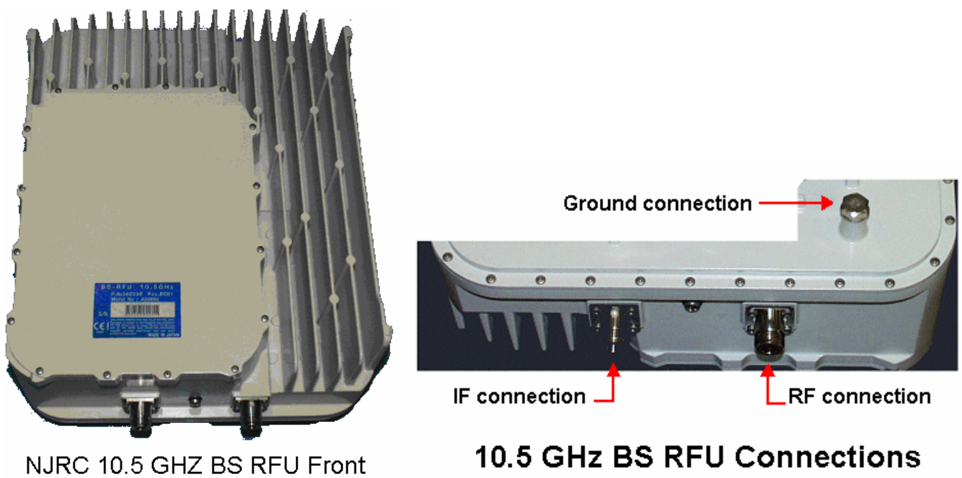


Figure 3-5: NJRC 10.5 GHz RFU Views

Installation Procedure

Installation Requirements

Table 3-2: 10.5 GHz RFU Installation Requirements	
Item	**Parameters**
Pole	2 to 4 inches in diameter.
Packing List	• BS-RFU unit • RF cable • 2 mounting brackets • 4 mounting straps • 8 bolts • Lock washers and flat washers.
Tools required	• 8 mm wrench. • 13 mm wrench

RFU Cable Connections Summary

The following table lists the RFU cable connections:

Table 3-3: 10.5 GHz Base Station RFU Cable Connections				
Cable	**From**	**To**	**Connectors**	**Note**
COAXIAL LMR400	RFU	IDU	N-Type	*Max. Length 150 m
Andrew LDF 3/8	RFU	Antenna	N-Type	Length 1m (supplied)
Grounding	RFU	Ground		M6 screw diameter
* For cable lengths greater than 150m, use a higher quality cable than the LMR400. Total cable attenuation must not exceed 20dB regardless of cable length.				

Mounting the 10.5 NJRC GHz RFU

To install the 10.5 GHz BS-RFU:

1. Referring to Figure 3-15 below, for each of the two mounting brackets, thread two mounting straps through the mounting bracket’s slots.

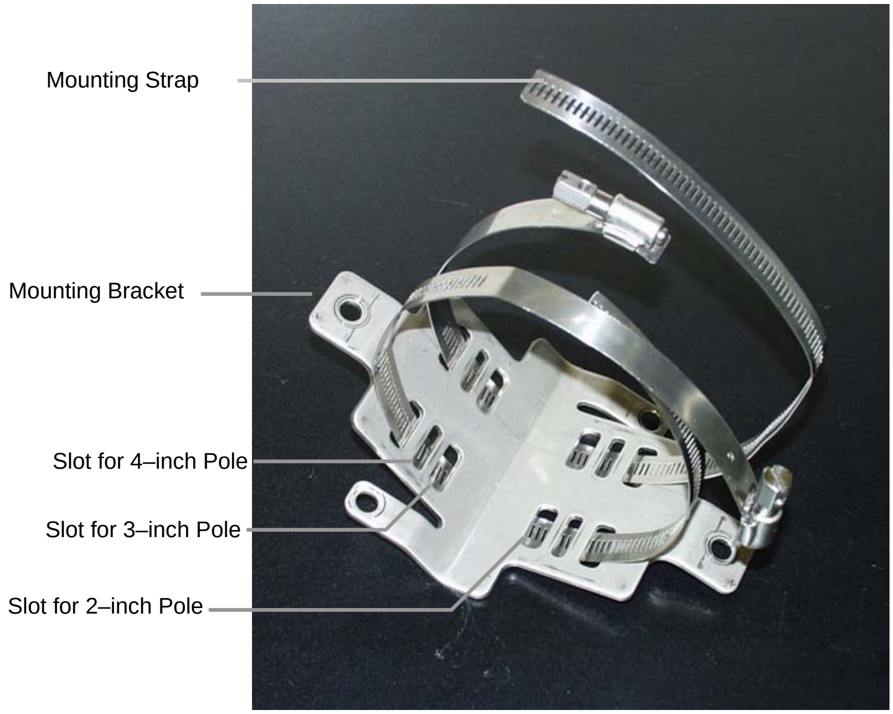


Figure 3-6: Mounting Bracket and Straps

Three sets of slots are provided to allow for differences in the diameter of the mast/pole: 2, 3 or 4 inches diameter.

2. Locate the eight mounting bolts (four for each bracket). Referring to Figure 3-16, bolt each if the mounting brackets (with straps already in place) to the rear of the BS-RFU

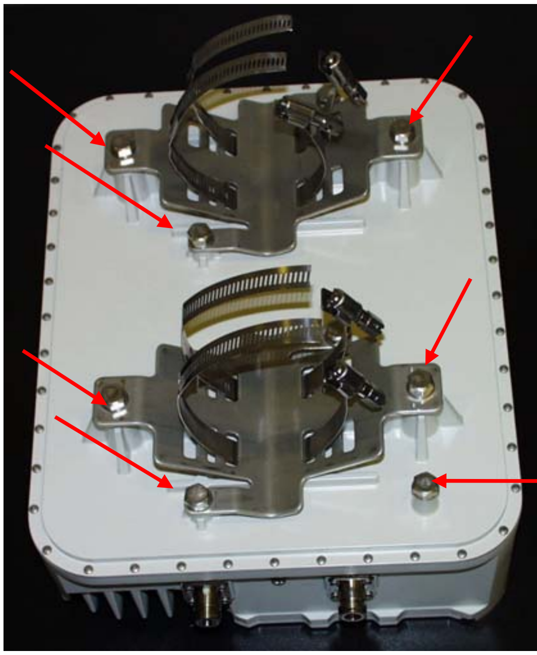


Figure 3-7: Mounting Brackets attached to BS-RFU

Before attaching the BS-RFU to the pole/mast, note the recommended relative positions of RFU and Antenna on the pole/mast (see Figure 3:17 below).

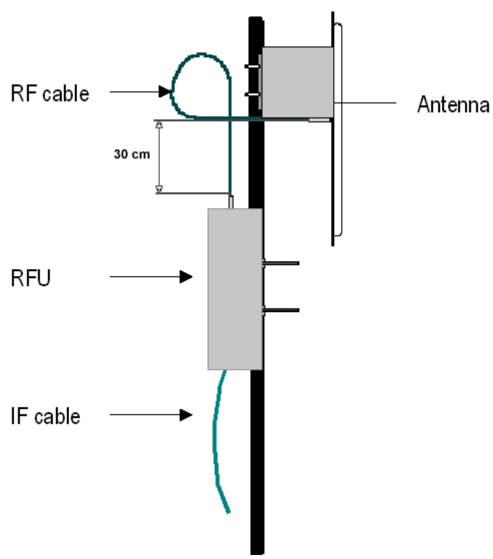


Figure 3-8 Recommended positioning of antenna and BS-RFU

3. Referring to the following figure, position the BS-RFU the correct way up. Attach the BS-RFU to the pole/mast. Tighten the mounting straps' adjustment screws.

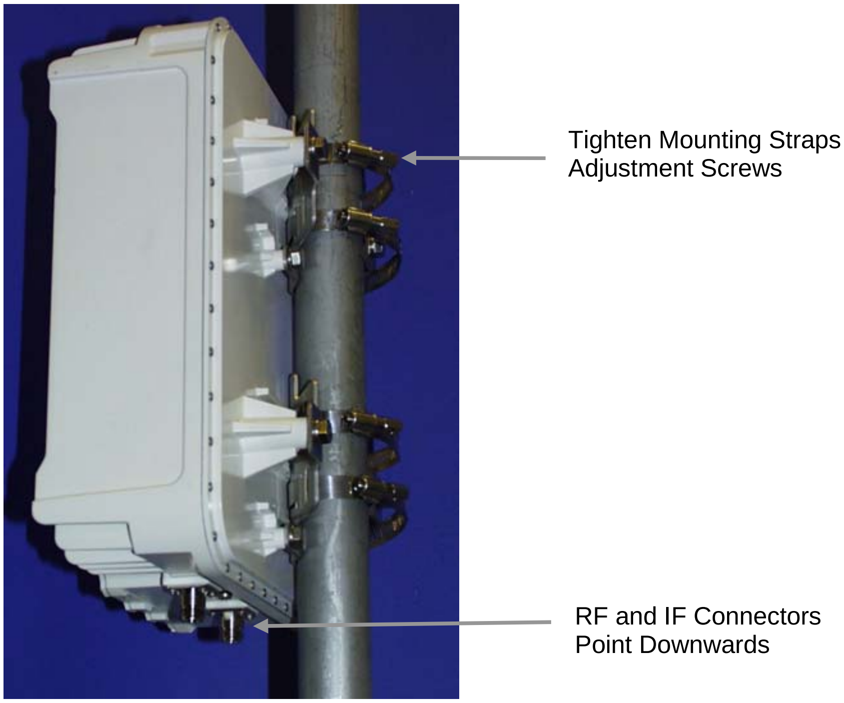


Figure 3-9: Attaching the BS-RFU to the Pole/Mast

4. Connect the ground cable to the grounding screw on the rear of the BS-RFU (see Figure 3-19 below).

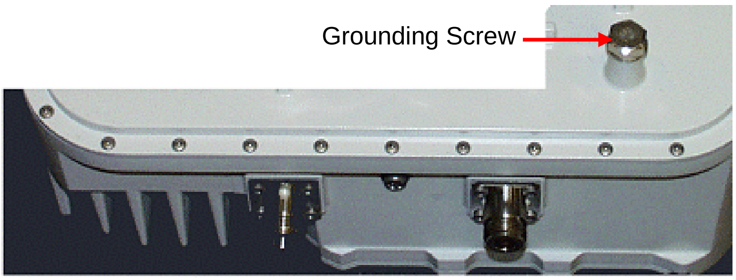


Figure 3-10: Attaching Ground Cable to Grounding Screw

5. Connect the RF and IF cables on the rear of the BS-RFU (see Figure 3-20 below).

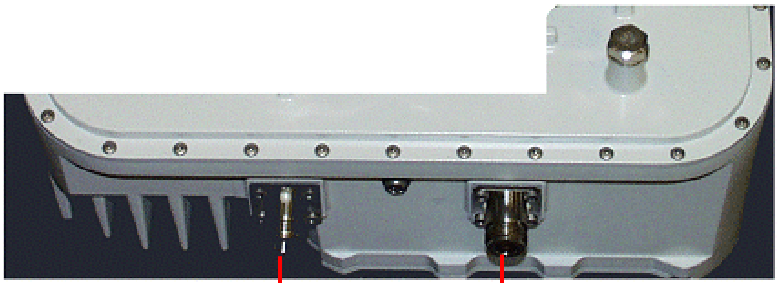


Figure 3-11: Attaching RF and IF Cables to the BS-RFU

NOTES:

- The IF cable connector must be a certified outdoor connector.
- The outdoor connectors should be tightened using sleeves.

When routing the coaxial cable, leave a service loop at the antenna to provide a sufficient length of cable to allow replacement of a faulty connector, when necessary. Secure the coaxial cable so that there is no mechanical stress at the antenna connection. Follow the superstructure with the coaxial cable to its base, and then to the building. If the coaxial cable requires suspension from the base to the building, use a stranded wire to support the coaxial cable weight (This support will prevent a migration of the cable's inner conductor to the shield.).

Installing the 10.5 GHz Base Station Antenna

Antenna Specifications

Table 3-4-: 10.5 GHz Base Station Antenna Dimensions

Antenna Beam width	Polarization	Size (mm.)	Weight (kg.)
60^0	Vertical	440x290x150	2.2
60^0	Horizontal	440x290x130	2.5
90^0	Vertical	360x265x20	1.0
90^0	Horizontal	340x180x40	1.0

BS 10.5 GHz 90º Sector Antenna

This section describes how to install 10.5 GHz 90° sector horizontal and vertical antennas.

BS 10.5 GHz 90º Horizontal Antenna

The following figure shows a 90º horizontal sector antenna.

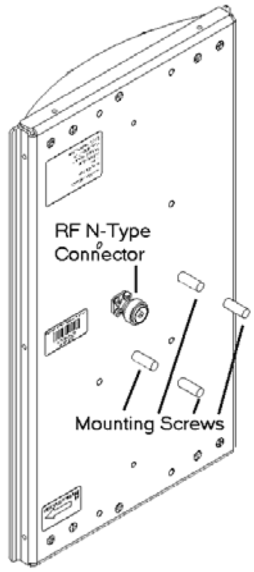


Figure 3-12: Base Station 90º Horizontal Sector Antenna

The following figure shows the assembly for the 90º horizontal sector antenna.

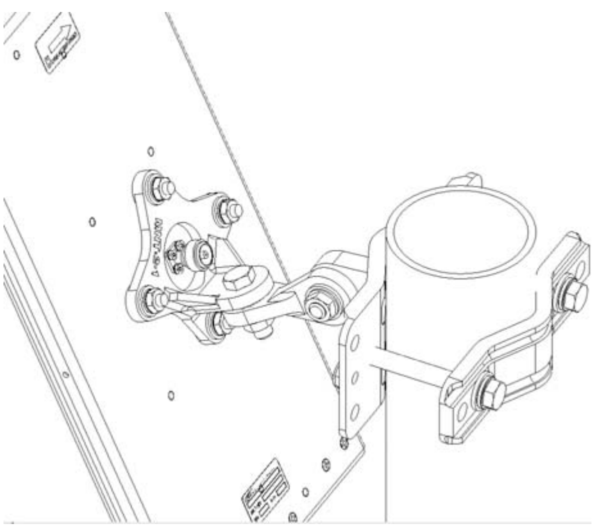


Figure 3-13: Base Station 90º Horizontal Sector Antenna Assembly

The following figure shows the assembly for the 90º horizontal sector antenna, with parts list.

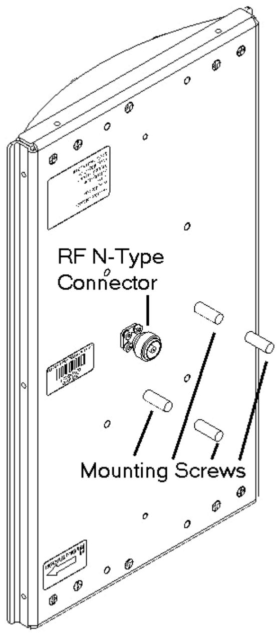


Figure 3-14: Base Station 90º Horizontal Sector Antenna Parts List

BS 10.5 GHz 90º Vertical Antenna

The Base Station10.5 GHz 90º Vertical Antenna is mounted with the MD - 1087 antenna mounting kit. See MD - 1087 Antenna Mounting Kit on page 3-15.

The following figures shows below show two views of a 10.5 GHz 90º vertical sector antenna.

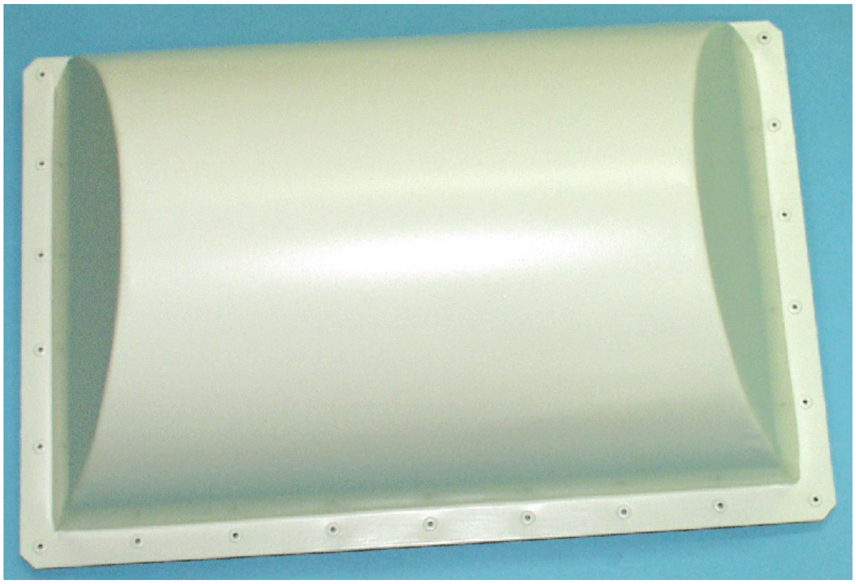


Figure 3-15: BS 10.5 GHz 90º Vertical Sector Antenna (top)

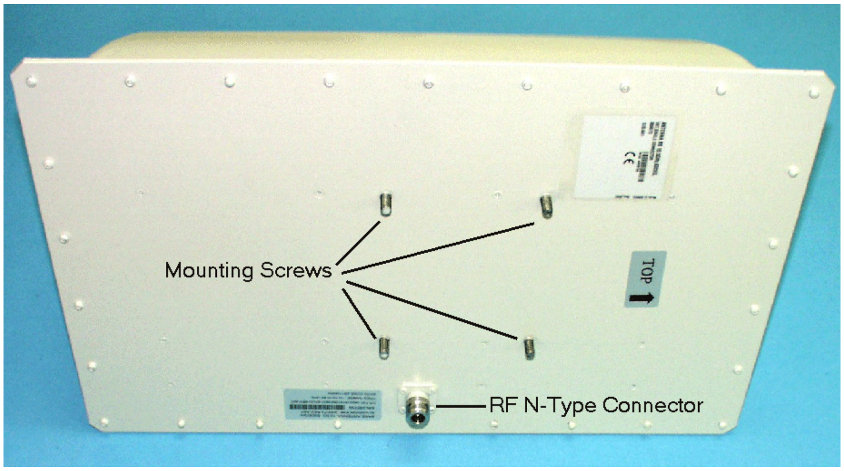


Figure 3-16: BS 10.5 GHz 90º Vertical Sector Antenna (bottom)

BS 10.5 GHz 60º Antenna

Antenna Views

The following figure show two views of a 10.5 GHz 60º V or H sector antenna.

Figure 3-17: BS 10.5 GHz 60º V or H Sector Antenna (top)

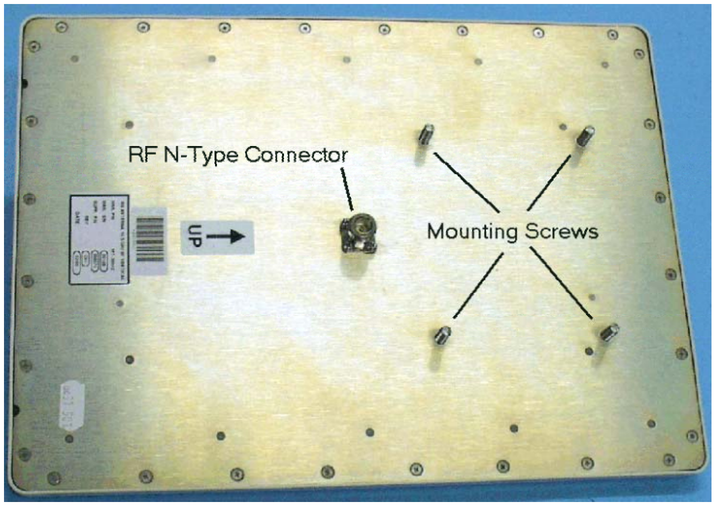


Figure 3-18: BS 10.5 GHz 60º V or H Antenna (bottom)- Vertical shown

Antenna Mounting Kit Assembly

The Base Station10.5 GHz 60º V or H Antenna is mounted with the MD - 1087 antenna mounting kit. See MD - 1087 Antenna Mounting Kit on page 3-15.

MD - 1087 Antenna Mounting Kit

The MD - 1087 Mounting Kit is used for the following Base Station antennas:

- Base Station 10.5 GHz 90º Vertical Antenna
- Base Station 10.5 GHz 60º V or H Antenna

MD –1087 Parts List

The mounting kit (Part No. MD-1087) consists of the following parts (see also Figure 3-28 and Figure 3-29).

Table 3-5: Mounting Kit - Part No. MD-1087

Part	Ref	Quantity
U – Bracket	1	1
Grooved Bracket	2	1
Band 2½– 4" diameter	3	2
Flat Washer ¼"	4	12
Spring Washer ¼"	5	8
Nut ¼"	6	8
Screw ¼"	7	4
Safety Pins	8	2

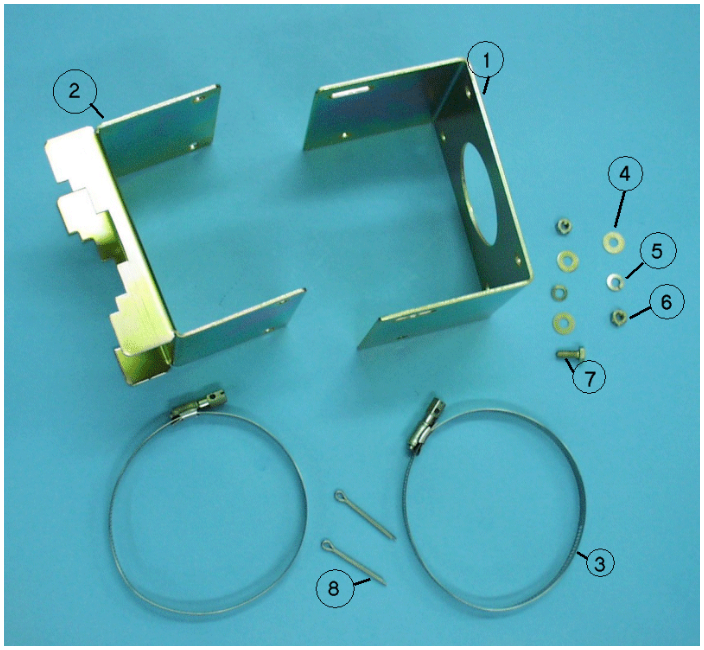


Figure 3-19: MD – 0087 Mounting Kit Parts

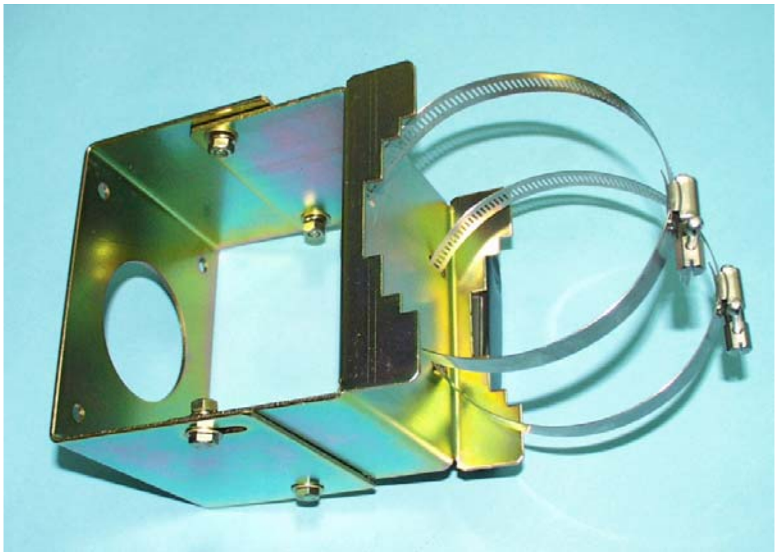


Figure 3-20: MD – 0087 Mounting Kit - Assembled

MD-1087 Assembly and Mounting

See the following figure for full installation instructions of how to assemble the MD-1087 mounting kit and attach it to a Base Station Antenna.

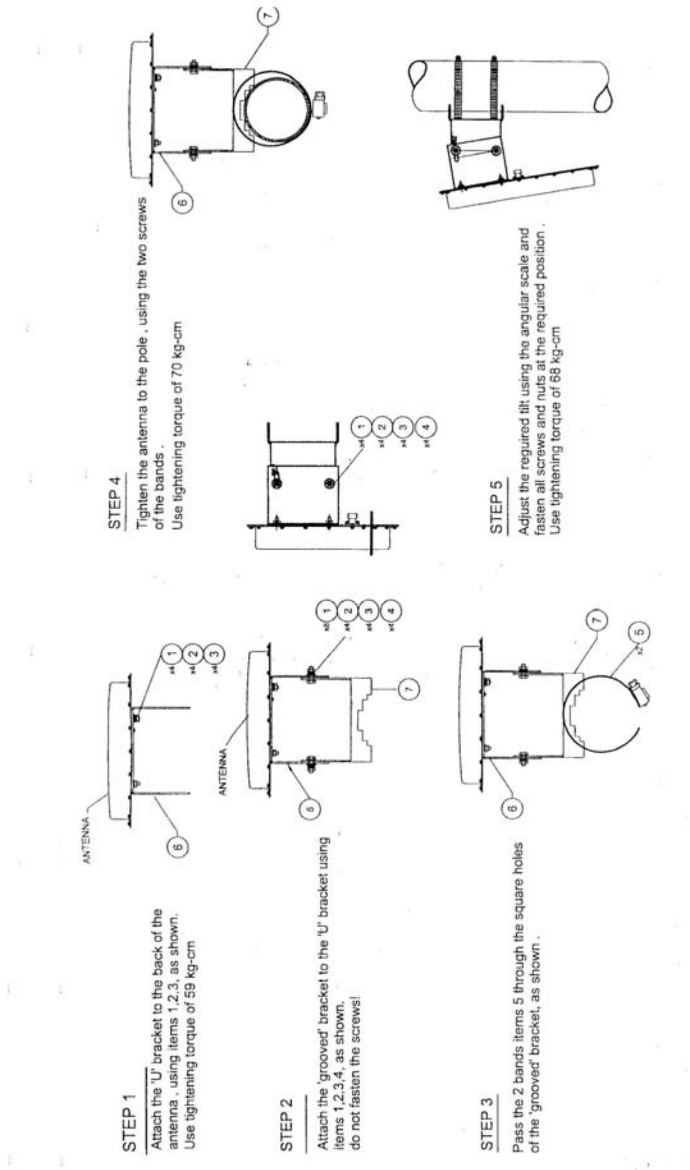


Figure 3-21: BS 60º Sector V or H Antenna Installation Instructions

Aligning the Base Station Antenna Using a Compass

Aligning the BS antenna using the compass takes into account the original azimuth of the Base Station and calculates a new azimuth that is 90o to the Base Station. The idea is to align the outer frame of the antenna so that it is more in line with the new azimuth, which will achieve greater accuracy.

Required tools:

- Compass
- Binoculars

To align the Base Station antenna:

1. Identify a reference point on the landscape that is in the direction of the heading of the Base antenna.
2. Depending on whether you are looking from the left or the right side of the antenna, add or subtract 90° to/from the Base Station azimuth.
3. Using the compass, align the outer frame of the antenna to the newly calculated azimuth, so that the flat surface of the antenna faces the reference point identified in step 1. This reference point is 90° to the Base antenna heading, as shown in Figure 2-6 below.

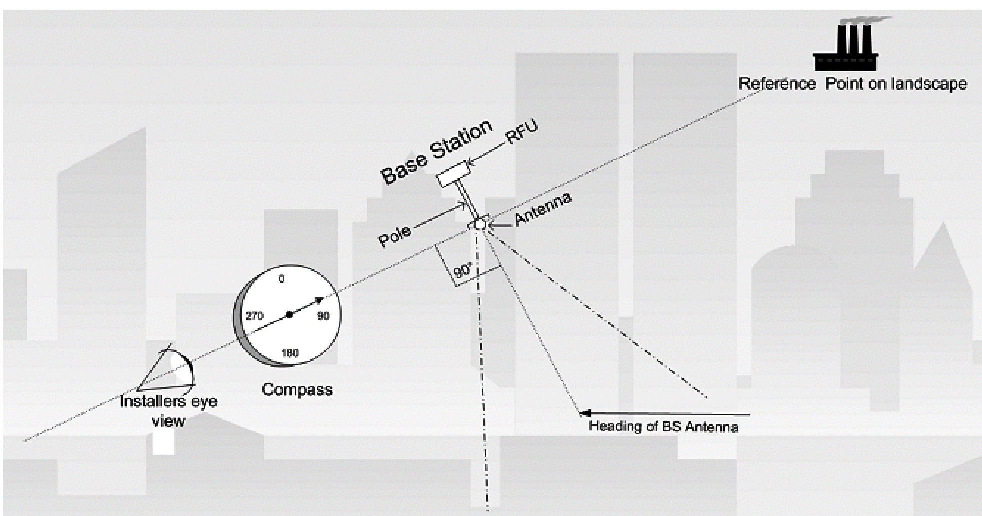


Figure 3-22: BS Antenna Alignment - Compass & Reference Point

4

Chapter 4 - 26 GHz Base Station ODU Installation

In This Chapter:

This chapter describes how to install the 26 GHz ODU.

General Guidelines

When installing the Base ODU, the following steps must be performed:

- Install the outdoor equipment, including the antenna.
- Connect RF and IF cables.
- Align the Base antenna (as described in the following section)
- Mount the unit.
- Ground the ODU.

Follow the guidelines below to ensure proper and smooth installation.

NOTE: Perform an RF survey at the beginning of an installation project to ensure that the spectrum is clear. Continue performing surveys every so often during the course of installation to ensure that no one is interfering with your spectrum.

Location and Orientation

- **Location:** the location of the RFU on the mast, the location and orientation (azimuth) of the antenna, including tilt when applicable, must be determined prior to installation.
- **Do not install the antenna at the top of the pole:** Always leave at least 40 cm space between the top of the pole and the antenna for better lightning protection.

Clearance around BS antennas

- To avoid frequency reuse problems caused by unwanted reflections, the main lobe of the antenna must be clear of any metallic objects for a range of up to 20 meters.
- In order to avoid the need to refer to particular antenna radiation patterns, the following criterion can be used: Clear metallic objects from a zone of up to 90 degrees to the right and left, and 45 degrees above and below, the antenna bore sight, for a distance of at least 20 meters.
- Make sure that there are no obstacles located in front of the WALKair antenna, such as masts, transmission equipment from other vendors, or another WALKair antenna. These kinds of obstacles can reflect power from the rear Terminals (which are behind the antenna) directly into the antenna's main beam, which can potentially decrease the Frequency Reuse performance.

Alignment

- **BS Antenna Alignment:** Proper alignment of the base antenna in the elevation plane is critical for decreasing the level of interference with neighboring cells. Therefore, be sure to balance the antenna pole before Elevation alignment. We recommend using an electronic level for proper pole balancing.

Inter-sector Distance

- **Inter-sector distance;** The minimal distance required between neighboring sectors is 1m, as shown below:

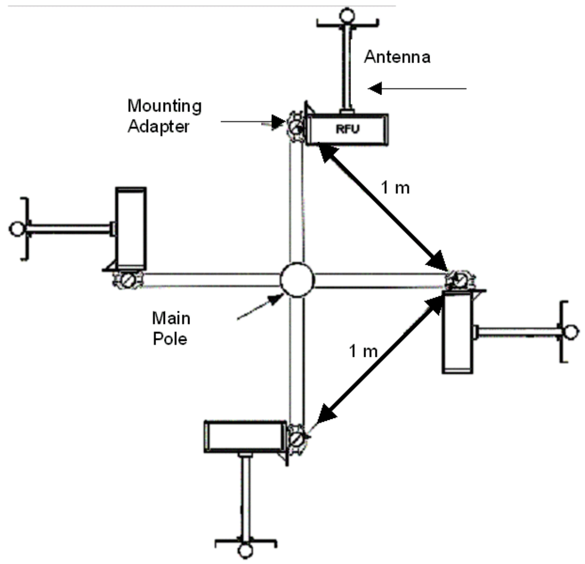


Figure 4-1: Distance between Neighboring Sectors (view from above)

Roof Corner Installation

When installing on a roof corner, leave a space of 0.5 meter above the railing and no less than 15 meters above the ground, as shown below:

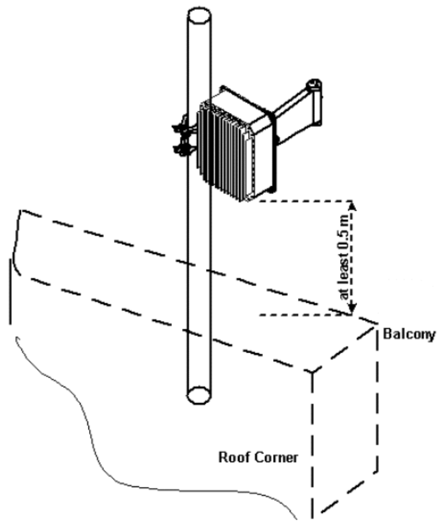


Figure 4-2: Installing on a Roof Corner

Redundancy Installations

For a redundancy installation, leave a space of 1m between the two ODUs using one of the two types of installation shown below.

NOTE: Before tightening the redundant antenna, verify that the alignment is the same as the original sector.

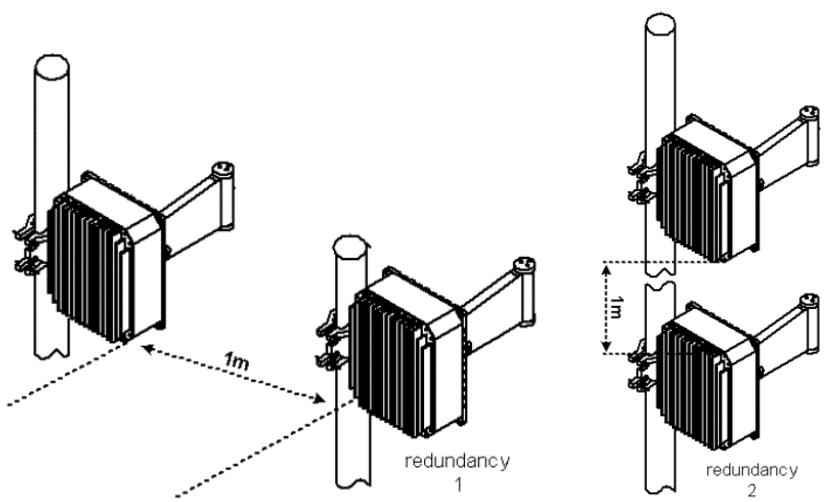


Figure 4-3: Redundancy Installations

Inspection

- Before leaving the installation site, check that all the hardware on the mount and antenna is secure.
- The antenna should be inspected at least once a year to check its condition and to ensure safe operation and maintenance.
- Qualified personnel, experienced in antenna installation, must perform this inspection.

Installation Procedure

Installation Requirements

The following tools are requried for the RFU installation procedure.

- Cross screwdriver
- Flat head screwdriver
- Adjustable wrench

Installing the 26 GHz ODU on a Mast

Two types of 26 GHz ODUs are provided:

- With a horn antenna
- With an integrated antenna

Both type of antennas are technically the same. The installation procedures for both types is given in the following sections. Perform the procedure relevant to your ODU type.

26 GHz ODU with a Horn Antenna

To install the ODU (RFU and antenna) on the mast:

1. Remove the contents from the box.
2. Remove the paper seal from the RFU/adapter.
3. Remove the plastic wave-guide dust cover from the back surface of the antenna as shown in Figure 4-4.

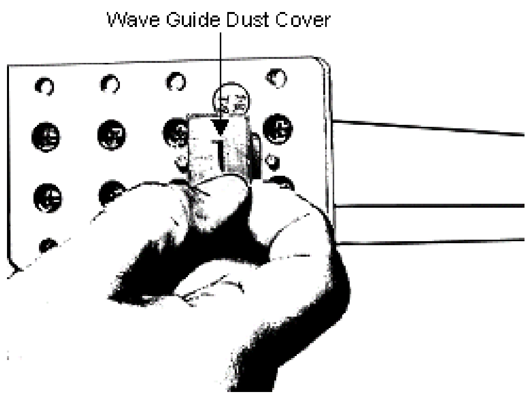


Figure 4-4: Removing the Plastic Wave Guide

4. Install the antenna shown in Figure 4-5 onto the RFU/adapter. Use the antenna guide pins (2) to align the antenna to the RFU/adapter. Press firmly into place.

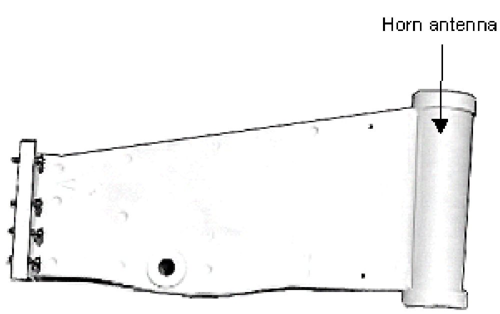


Figure 4-5: Horn Antenna

5. Fasten the antenna to the RFU/adapter with the 8 screws (size 6/32 or 18 mm), washers and lock-washers provided, as show in Figure 4-6.

Figure 4-6: Fastening the Antenna

6. Remove all screws from the brass plate as shown in Figure 4-7.

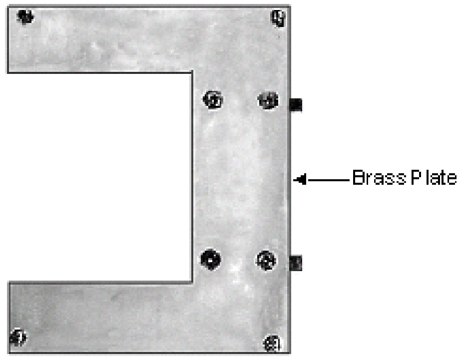


Figure 4-7: Removing the Screws from the Brass Plate

7. Remove the bolts, washers, and lock-washers from the mounting bracket as shown in Figure 4-8.

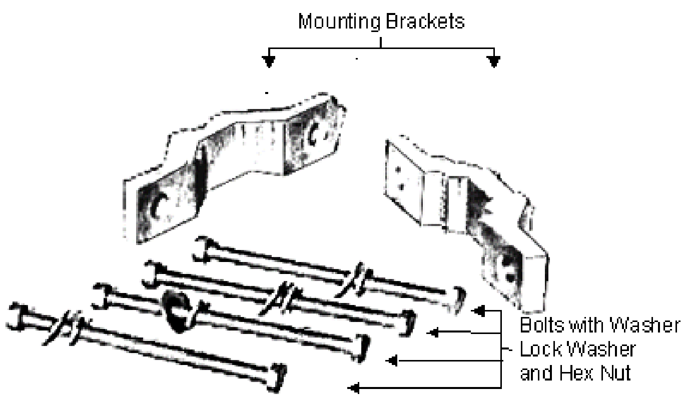


Figure 4-8: Mounting Brackets

8. Fasten the elevation adjustment plate to the brass plate, as shown in Figure 4-9.

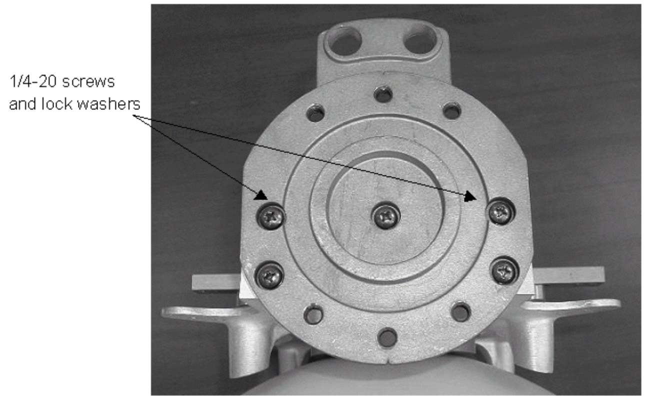


Figure 4-9: Mounting the Elevation Adjustment Plate

9. Slide two mounting bracket bolts through the mini-elevation plate as is shown in Figure 4-10.

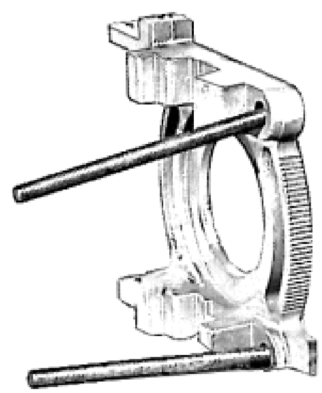


Figure 4-10: Mini Elevation Plate

10. Place the mini-elevation plate on top of the elevation plate as shown in Figure 4-11. Ensure that the top surfaces of both plates are aligned parallel to each other. This will provide 0° elevation.

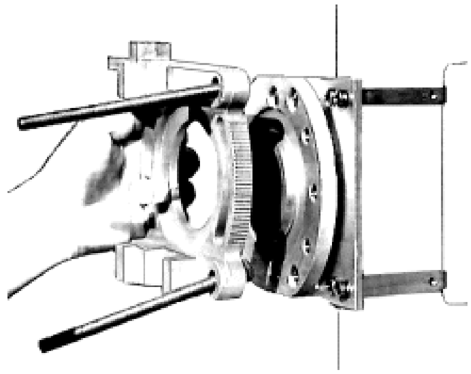


Figure 4-11: Mini-elevation Plate placed on Elevation Plate

11. Fasten two elevation bolts, spacers, washers and lock-washers in the center holes (#2 and #5) of the mini-elevation plate as shown in Figure 4-12

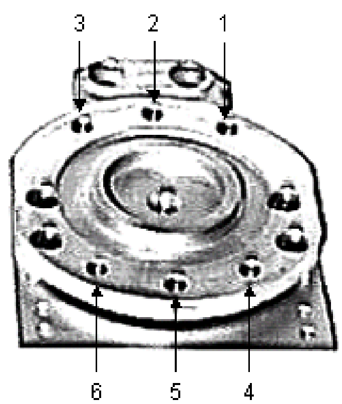


Figure 4-12: Fastening the Mini-elevation Plate

12. Fasten the remaining elevation bolts, spacers, washers and lock-washers as follows (see Figure 4-13):

- ♦ Use holes #3 and #4 for right-mounting the RFU
- ♦ Use holes #1 and #6 for left-mounting the RFU

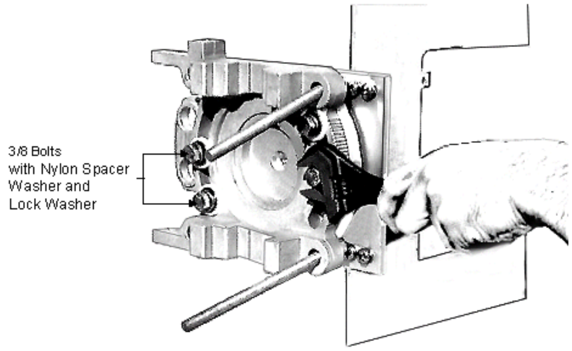


Figure 4-13: Fastening the Remaining Bolts

13.Insert the remaining mounting bracket bolts into the elevation plates as shown in Figure 4-14.

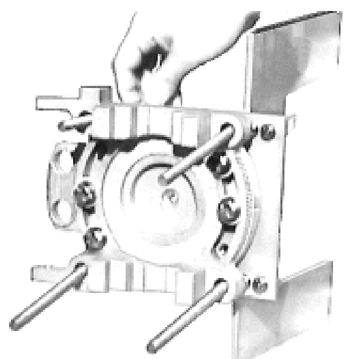


Figure 4-14: Inserting the Remaining Mounting Bracket Bolts

14. Fasten the unit to the mast using the mounting brackets, washers, lock-washers and hex nuts (fully tighten the hex nuts) as shown in Figure 4-15

NOTE: Prior to installation, determine whether the RFU will be right or left mounted

---

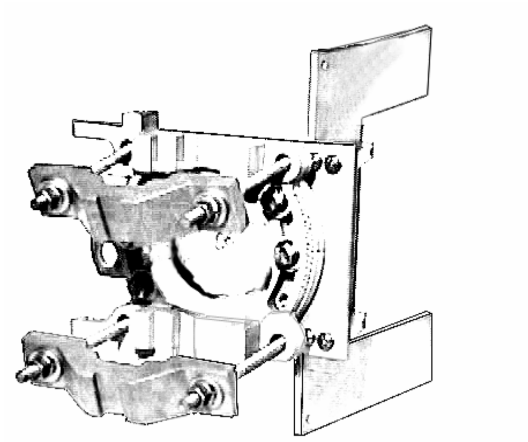


Figure 4-15: Fastening the Unit to the Mast

15.Align the unit temporarily to the mast.

NOTES:

- It is recommended to fasten the mounting brackets, washers, lock-washers and hex nuts onto the mounting bolts before climbing to the top of the mast.
- Use the assembled mounting brackets as a handle to carry the unit to the mast top

16.Fasten the ODU (RFU and antenna) to the brass plate using the four screws, washers and lock-washers provided.

17.Align the four corner holes of the brass plate with the four corner holes of the RFU as shown in Figure 4-16.

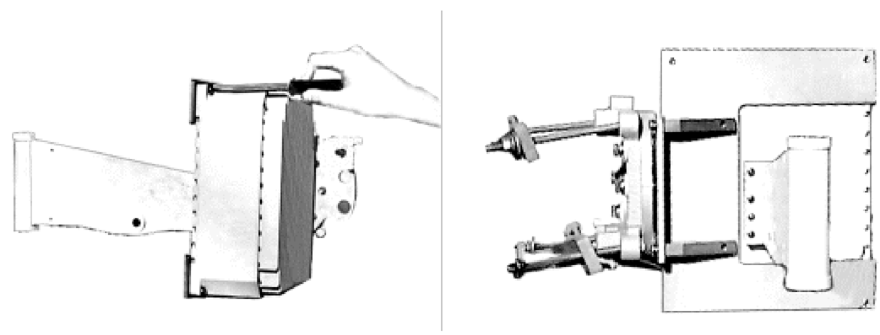


Figure 4-16: Aligning the Four Corner Holes

26 GHz ODU with an Integrated Antenna

To install the 26 GHz ODU with an integrated antenna on a mast

1. Remove the contents from the box.
2. Remove the paper seal from the RFU/adapter.
3. Remove the bolts, washers, and lock-washers from the mounting bracket as shown in Figure 4-8.

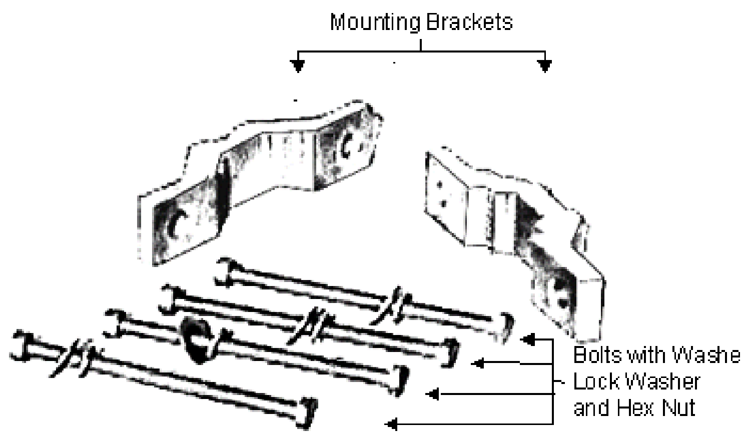


Figure 4-17: Mounting Brackets

4. Fasten the elevation adjustment plate to the unit, as shown in Figure 18. Use 4 x M6 screws with M6 washers and M6 spring washers to connect the mounting adaptor to the Radio.

CAUTION

Do not touch or lean on the antenna radome.

Tightening Torque: 6.4 [N.M] 57 [Lbf.in]

Figure 4-18: Mounting the Elevation Adjustment Plate

5. Slide two mounting bracket bolts through the mini-elevation plate as shown in Figure 4-10.

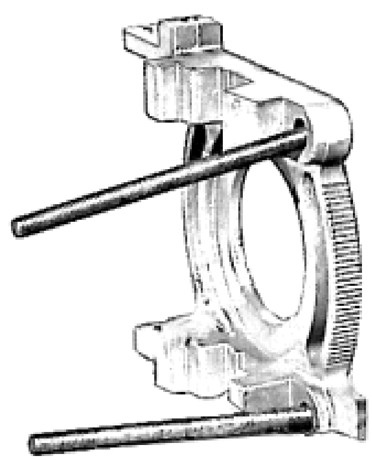


Figure 4-19: Mini Elevation Plate

6. Place the mini-elevation plate on top of the elevation plate as shown in Figure 4-11. Ensure that the top surfaces of both plates are aligned parallel to each other. This will provide 0° elevation.

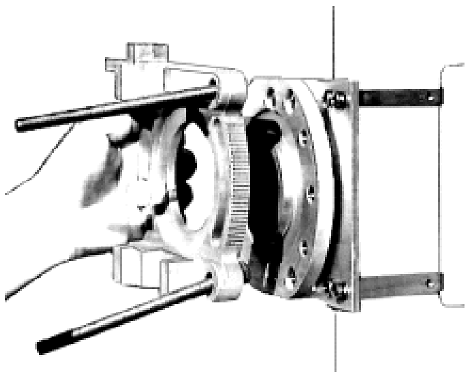


Figure 4-20: Mini-elevation Plate placed on Elevation Plate

7. Fasten two elevation bolts, spacers, washers and lock-washers in the center holes (#2 and #5) of the mini-elevation plate as shown in Figure 4-12.

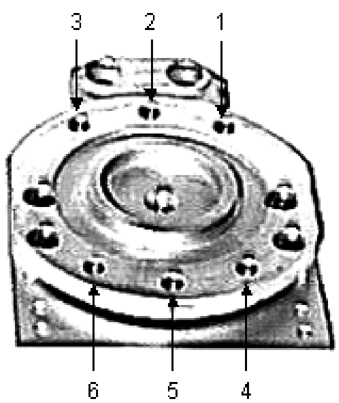


Figure 4-21: Fastening the Mini-elevation Plate

8. Fasten the remaining elevation bolts, spacers, washers and lock-washers as follows (see Figure 4-13):
   - ➢ Use holes #3 and #4 for right-mounting the RFU.
   - ➢ Use holes #1 and #6 for left-mounting the RFU.

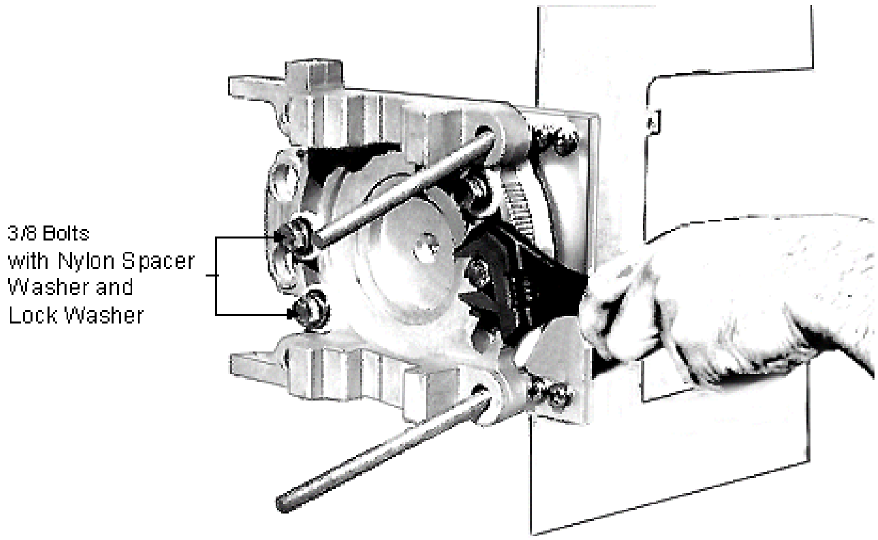


Figure 4-22: Fastening the Remaining Bolts

9. Insert the remaining mounting bracket bolts into the elevation plates as shown in Figure 4-14.

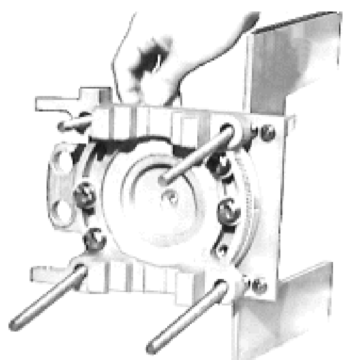


Figure 4-23: Inserting the Remaining Mounting Bracket Bolts

10. Fasten the unit to the mast using the mounting brackets, washers, lock-washers and hex nuts (fully tighten the hex nuts) as shown in Figure 4-15.

NOTE: Prior to installation, determine whether the RFU will be right or left mounted.

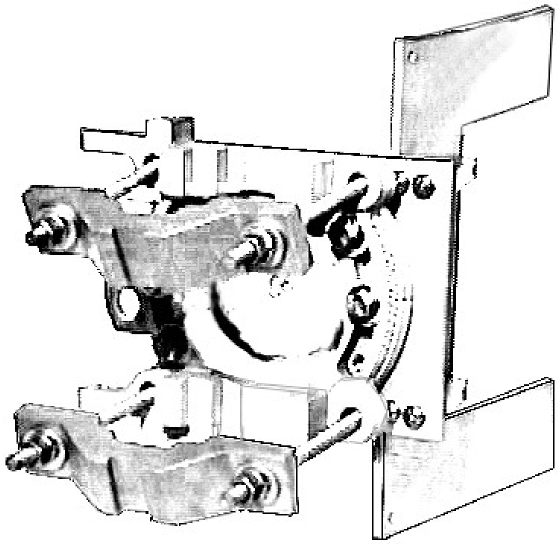


Figure 4-24: Fastening the Unit to the Mast

11. Align the unit temporarily to the mast.

NOTES:

It is recommended to fasten the mounting brackets, washers, lock-washers and hex nuts onto the mounting bolts before climbing to the top of the mast.

Use the assembled mounting brackets as a handle to carry the unit to the mast top.

---

12. Fasten the ODU (RFU and antenna) to the brass plate using the four screws, washers and lock-washers provided.

Connecting the Cables

The procedure consists of connecting the ground and RF cables. See Table 4-1 and Figure 4-25. Note that a single coaxial cable is connected between each sector RFU and the respective sector IDU IF MUX/Power Feeder.

NOTE: For a cable length greater than 150m, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB regardless of its length.

Table 4-1: BS 26 GHz ODU Cable Connections

Cable	Connector	From	To
COAX 50Ω	N-Type	RFU	BS-SA/IF-MUX/DEMUX
Grounding	M6 screw diameter	RFU	Ground

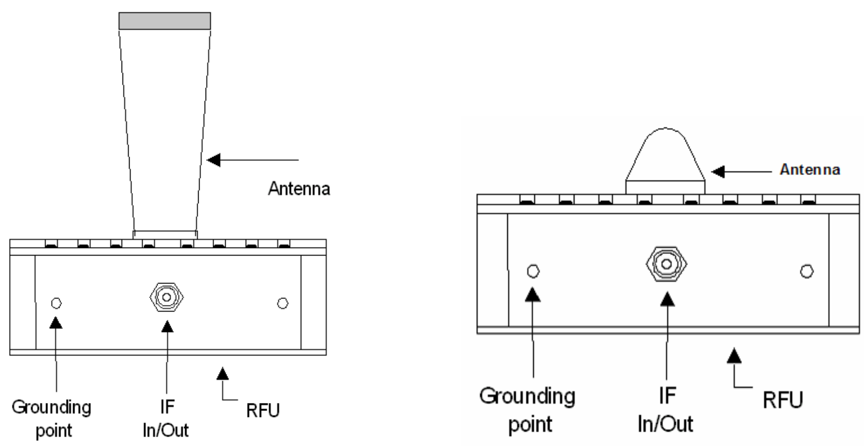


Figure 4-25: Connections for 26 GHz BS ODU with Horn (left) and Integrated (right) antenna

Connecting the Ground/Earth Cable

To connect the ground/earth cable:

- Referring to Figure 4-25, connect the ground/earth cable to the BS ODU.

Connecting the IF cable

To connect the IF Cable:

- Referring to Figure 4-25, connect a single coaxial cable is between the ODU and the IDU.

NOTE: For a cable length greater than 110m, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB.

- Referring to Figure 4-26, when routing the coaxial cable, leave a **service loop** at the RFU end to provide a sufficient length of cable to allow replacement of a faulty connector, when necessary.
- Secure the coaxial cable so that there is no mechanical stress at the RFU connection. Follow the superstructure with the coaxial cable to its base, and then to the building.
- If the coaxial cable requires suspension from the base to the building, use a stranded wire to support the coaxial cable weight (This support will prevent a migration of the cable's inner conductor to the shield.).

- Sealing the ODU Connector – See Sealing the ODU Connector.

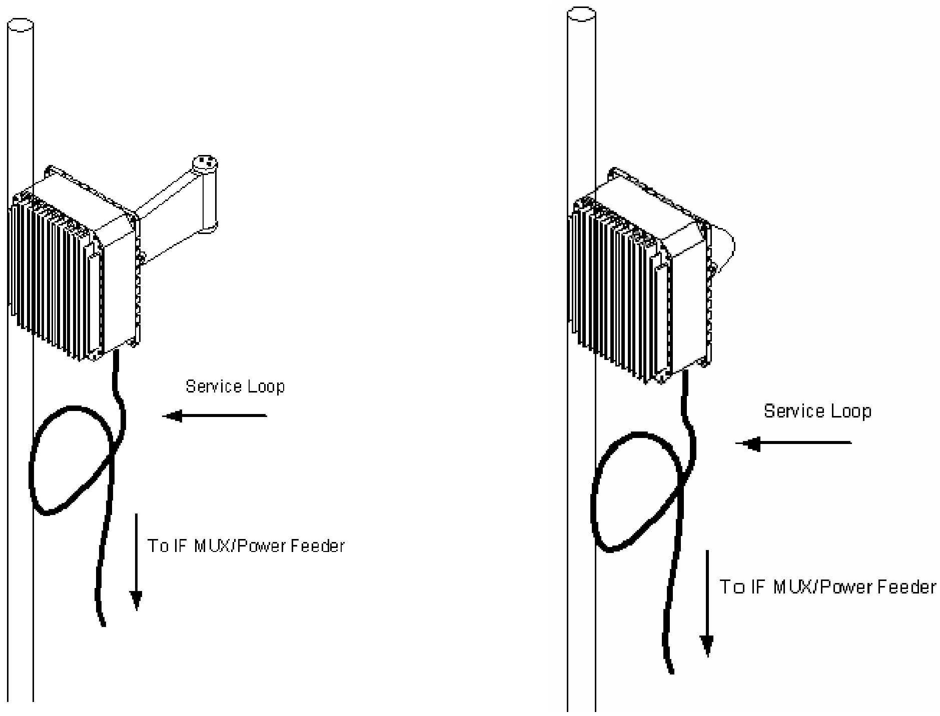


Figure 4-26: Service Loop for BS 26 GHz ODU with Horn (left) and Integrated (right) Antenna

CAUTION
The IF cable connector must be a certified outdoor connector. The outdoor connectors should be tightened using sleeves.

5

Chapter 5 - 28 GHz Base Station ODU Installation

In This Chapter:

This chapter describes how to install the 28 GHz BS ODU..

General Guidelines

When installing the Base ODU, the following steps must be performed:

- Install the outdoor equipment, including the antenna.
- Connect RF and IF cables.
- Align the Base antenna (as described in the following section)
- Mount the unit.
- Ground the ODU.

Follow the guidelines below to ensure proper and smooth installation.

NOTE: Perform an RF survey at the beginning of an installation project to ensure that the spectrum is clear. Continue performing surveys every so often during the course of installation to ensure that no one is interfering with your spectrum.

Location and Orientation

- **Location:** the location of the RFU on the mast, the location and orientation (azimuth) of the antenna, including tilt when applicable, must be determined prior to installation.
- **Do not install the antenna at the top of the pole:** Always leave at least 40 cm space between the top of the pole and the antenna for better lightning protection.

Clearance around BS antennas

- To avoid frequency reuse problems caused by unwanted reflections, the main lobe of the antenna must be clear of any metallic objects for a range of up to 20 meters.
- In order to avoid the need to refer to particular antenna radiation patterns, the following criterion can be used: Clear metallic objects from a zone of up to 90 degrees to the right and left, and 45 degrees above and below, the antenna bore sight, for a distance of at least 20 meters.
- Make sure that there are no obstacles located in front of the WALKair antenna, such as masts, transmission equipment from other vendors, or another WALKair antenna. These kinds of obstacles can reflect power from the rear Terminals (which are behind the antenna) directly into the antenna's main beam, which can potentially decrease the Frequency Reuse performance.

Alignment

- **BS Antenna Alignment:** Proper alignment of the base antenna in the elevation plane is critical for decreasing the level of interference with neighboring cells. Therefore, be sure to balance the antenna pole before Elevation alignment. We recommend using an electronic level for proper pole balancing.

Inter-sector Distance

- **Inter-sector distance;** The minimal distance required between neighboring sectors is 1m, as shown below:

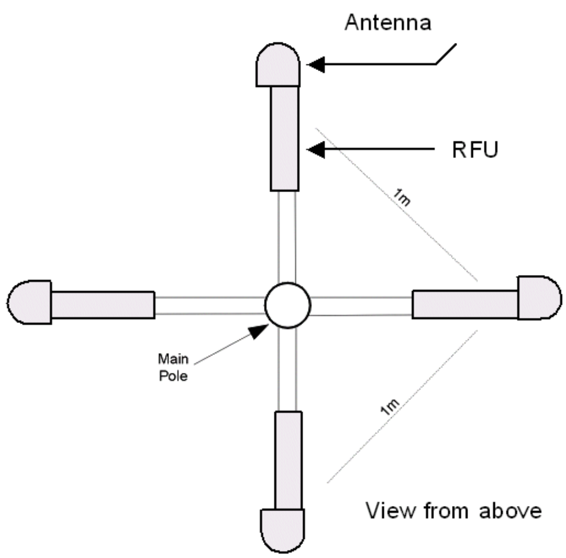


Figure 5-**1: Distance between Neighboring Sectors (view from above)**

Roof Corner Installation

When installing on a roof corner, leave a space of 0.5 meter above the railing and no less than 15 meters above the ground, as shown below:

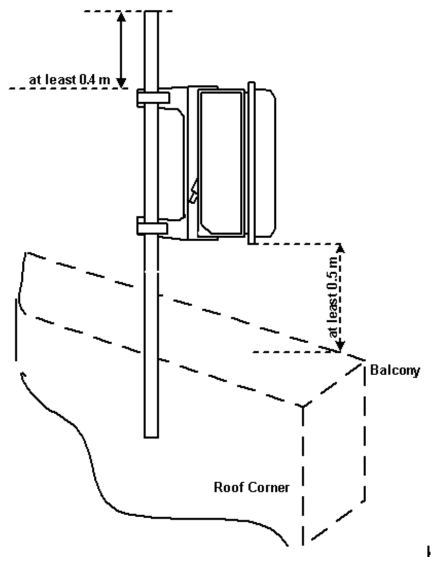


Figure 5-2: Installing on a Roof Corner

Redundancy Installations

For a redundancy installation, leave a space of 1m between the two ODUs, either vertically or horizontally (installed on separate masts).

NOTE: Before tightening the redundant antenna, verify that the alignment is the same as the original sector.

Inspection

- Before leaving the installation site, check that all the hardware on the mount and antenna is secure.
- The antenna should be inspected at least once a year to check its condition and to ensure safe operation and maintenance.
- Qualified personnel, experienced in antenna installation, must perform this inspection.

Installation Procedure

Tools Required for Installation

Tools Required:

- Cross screwdriver
- Flat head screwdriver
- Adjustable wrench
- Spirit Level

BS-RFU Management Software and Hardware

NOTE: It is recommended to configure the RFU indoors before mounting it on the mast.

Optional software purchased from Alvarion is used to electronically configure the RF Gain of a 28 GHz Base Station antenna via a laptop computer (see Configuring the RF Gain Using Optional BS-RFU Management Software,
on page 5-11).

The following equipment is required:

- Laptop computer with Windows OS
- Optional Software application for Base Station:
  See WALKair 3000 Price List item -
  BS-RFU Management SW for Windows
  (to install, copy it from the software CD to the laptop)
- RS-232 Cable with one male and one female D-Type termination:
  pin-outs as follows:

Laptop	TS	Signal
5	5	GND
2	3	TX
3	2	RX

Mounting BS 28 GHz ODU on a Mast

The BS 28 GHz ODU is supplied with the RFU, antenna and mounting adapter already assembled as a unit as shown in Figure 5-3.

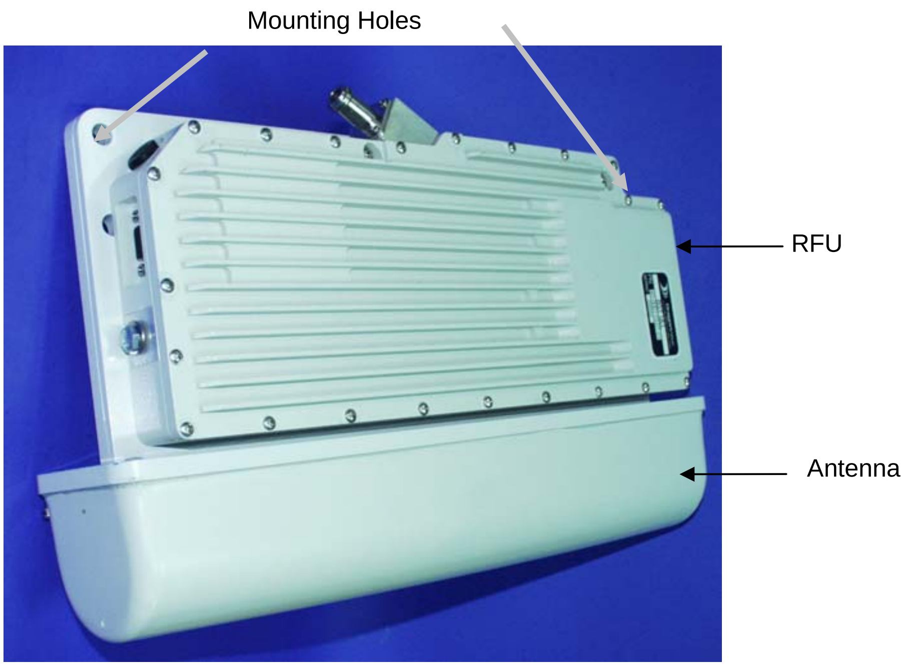


Figure 5-3: BS-ODU as supplied

The assembled mounting kit bracket attaches to a vertical pipe ranging in diameter from 2-3/8" (60mm) to 4-1/2" (114mm).

Mounting the Base Station 28 GHz ODU includes:

- Mounting the BS 28 GHz ODU Brackets on page 5-7
- Setting the Azimuth on page 5-9
- Attaching the BS 28 GHz ODU to the assembly on page 5-9
- Adjusting the elevation on page 5-10
- Configuring RFU Gain Using Optional BS-RFU Management Software, on page 5-11
- Connecting the Cables on page 5-11

Installing the Mounting Brackets

To assemble the mounting brackets:

1. Locate the antenna mounting bracket and the elevation adjustment assembly.

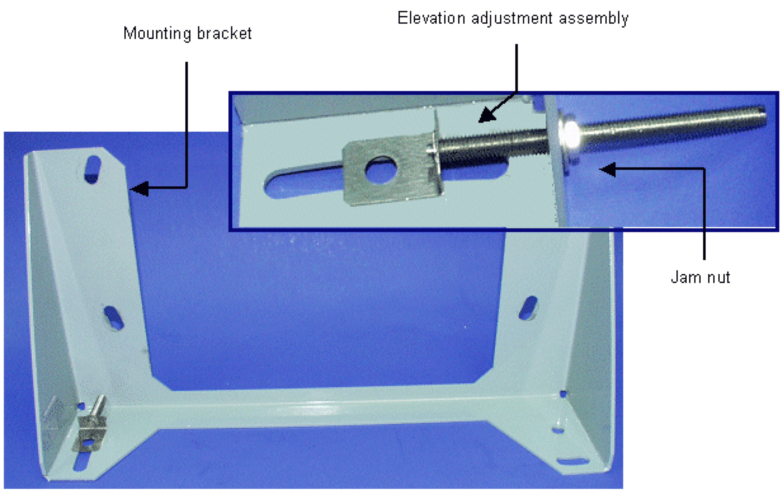


Figure 5-4: Threading the Elevation Adjustment Assembly

2. Thread the elevation adjustment assembly into the correct mounting bracket hole.
3. Lay the mounting bracket flat so that the slot and hole are centered. Loosely thread on the jam nut of the elevation bracket assembly.

4. Referring to Figure 5-5, assemble the two mounting braces and V-clamps to the pole/mast, each with two M10 x 160 mm hex head bolts and M10 flat washers.

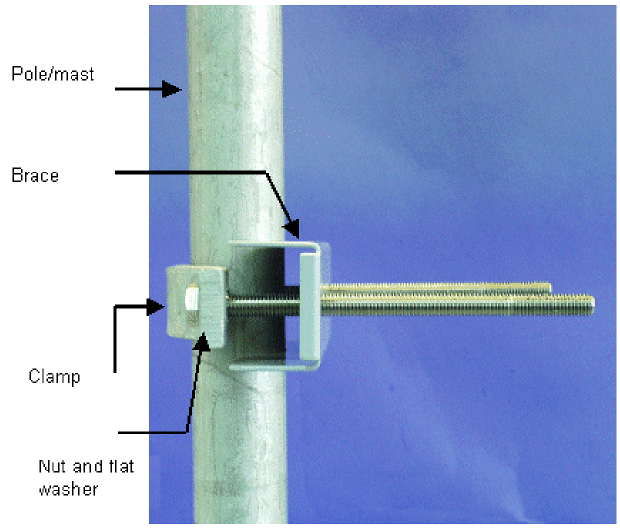


Figure 5-5: Attaching Brace and Clamp (one shown)

5. Referring to Figure 5-6, attach the antenna mounting bracket to the upper and lower braces using the M10 flat washer, M10 split lock washer and M10 hex nut (two nuts for the upper brace and two nuts for the lower brace).

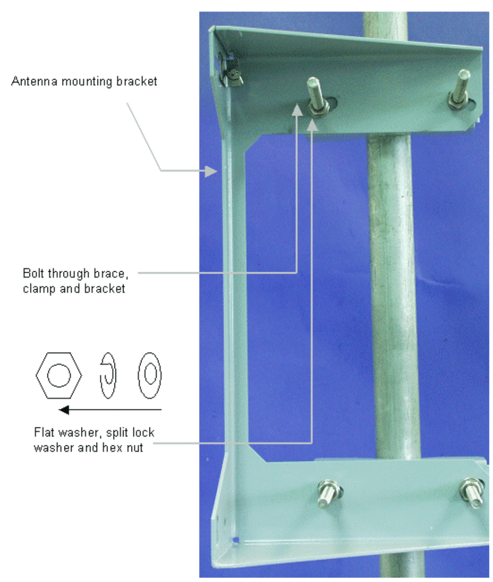


Figure 5-6: Attaching Antenna Mounting Bracket

6. Tighten the nuts so that the assembly is clamped to the pole/mast but is free to rotate around it. This will enable adjustments to the bracket assembly later on.

Setting the Azimuth

To set the azimuth for the 28 GHz BS ODU:

1. Using a compass, optical sight or other suitable apparatus, rotate the pole/mast braces and V-clamps to the required azimuth.
2. Tighten the four nuts on the antenna mounting bracket bolts so that the assembly is held in place, but movement is possible.
3. Place a spirit level on the mount and adjust the mount to its vertical position (see Figure 5-7. Tighten the nuts fully.

Figure 5-7: Setting the Azimuth

Assembling the 28 GHz BS ODU

To assemble the 28 GHz BS ODU:

1. Referring to Figure 5-8, assemble the BS 28 GHz ODU to the antenna mounting bracket using:

- Two M10 x 40 mm hex head bolts,
- M10 flat washers (one for the inside and one for the outside of the antenna),
- M10 split lock washers and
- Hex nuts.

2. Do not fully tighten the assembly in order to enable later adjustments.

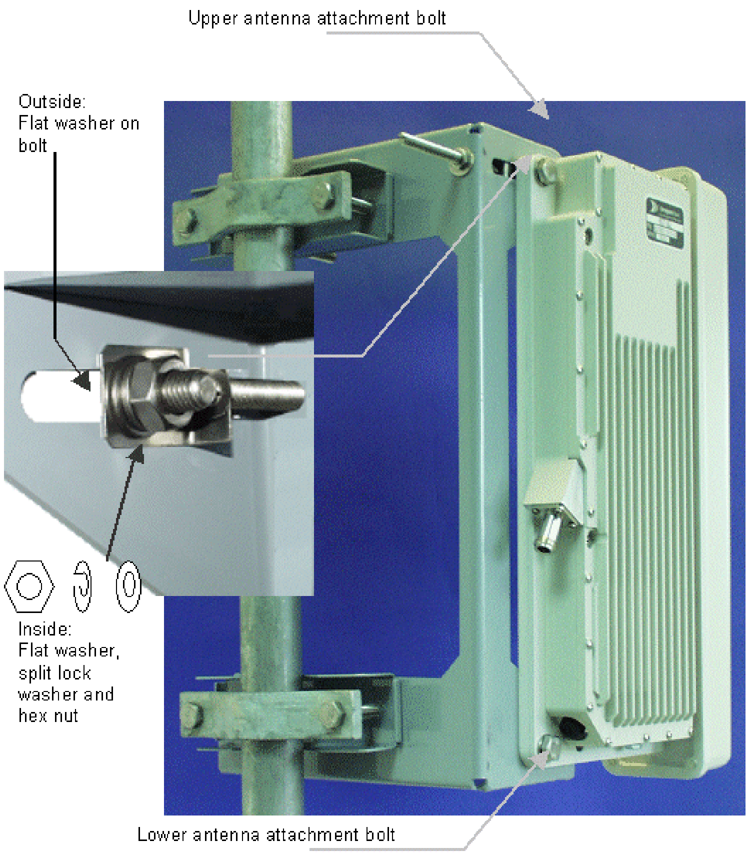


Figure 5-8: Attaching the BS 28 GHz ODU to the Assembly

Adjusting the Elevation

To adjust the 28 GHz BS ODU elevation:

1. Obtain the elevation tilt angle from the System Planner.
   Referring to Figure 5-9, place a spirit level on the top surface of the antenna. Adjust the elevation tilt (jam nut) until the required angle is achieved.
2. Tighten the antenna mounting bolts and the elevation tilt angle adjustment jam nut. After tightening, recheck the tilt angle.

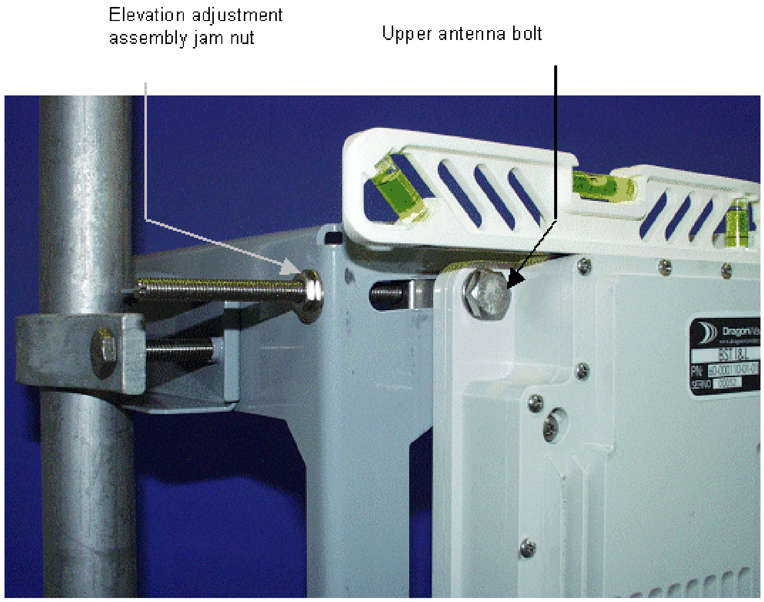


Figure 5-9: Adjusting the Elevation

Configuring RF Gain Using Optional BS-RFU Management Software

The BS-RFU Radio Gain for RX and TX is set and the maximum signal reception is detected by locally connecting to the unit from a laptop running the (optional) BS-RFU Management Software.

See also Optional BS-RFU Management Software and Hardware, on page 5-5.

To configure the RF Gain using the BS-RFU Management Software

1. Referring to Figure 5-10, locate the software connector weatherproof cover at the underside of the BS RFU. Release the four fixing screws and put them along with the cover in a safe place.

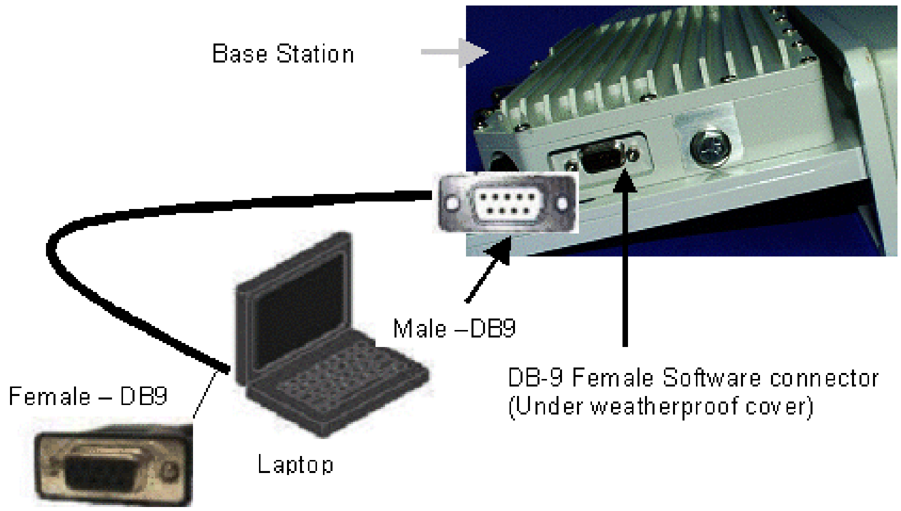


Figure 5-10: BS Software Connection

2. Attach a D-Type cable from the laptop to the Base Station software connector. (See also Optional BS-RFU Management Software and Hardware, on page 5-5).
3. Launch BS-RFU Management Software on the laptop. The Main window appears.

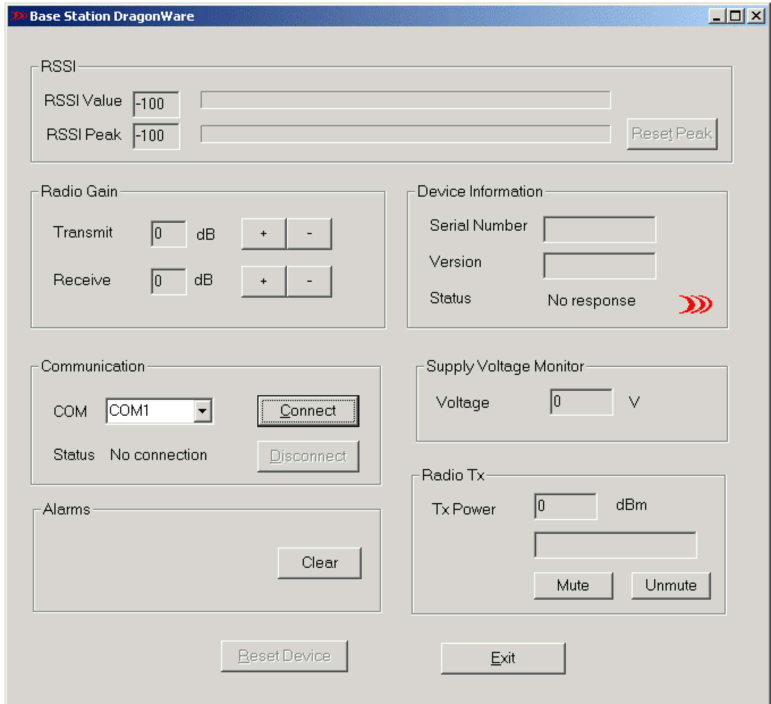


Figure 5-11: BS-RFU Management Software Window

4. Click the 

 button to connect to the Base Station. The Base Station Serial Number and Version Number, and Status "running", will appear in the Device Information section.

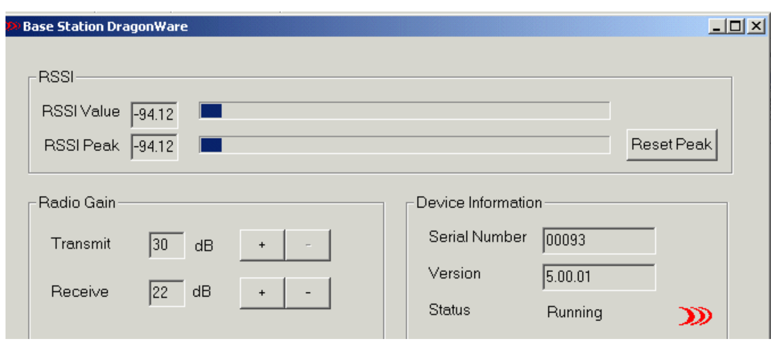


Figure 5-12: BS-RFU Management Software Window (partial view), after Login

5. Check the Base Station Supply Voltage in *the Supply Voltage Monitor* area, and the Tx Power in the *Radio Tx* area.
6. Referring to Table 5-1, select the Transmit (Tx) and Receive (Rx) Gain values (in DBm), corresponding to the Cable Gain (attenuation) for your system in dBm
7. In the *Radio Gain* area of the window, using the adjacent 

 buttons, enter the Transmit (Tx) and Receive (Rx) Gain values (from the previous step).

Table 5-1: BS Radio Gain as a Function of Cable Gain (Attenuation)

Tx		Rx	
Tx Gain	**Cable Gain**	**Rx Gain**	**Cable Gain**
45	-20	40	-12
44	-19	39	-11
43	-18	38	-10
42	-17	37	-9
41	-16	36	-8
40	-15	35	-7
39	-14	34	-6
38	-13	33	-5
37	-12	32	-4
36	-11	31	-3
35	-10	30	-2
34	-9		
33	-8		
32	-7		
31	-6		
30	-5		
29	-4		
28	-3		
27	-2		

7. Click the 

button to exit the software, and *disconnect* the cable from the Base Station.

Connecting the Cables

The procedure consist of connecting the ground and the IF cables listed in Table 5-2 to the connections shown in Figure 5-13.

Table 5-2: BS 28 GHz Cables and Connections

Cable	Connector	From	To
IF/DC	COAX 50 Ω N-Type	BS ODU	BS IDU
Ground/earth	M6 screw diameter	BS ODU	Ground/earth
Management	D-Type 9 pin	BS ODU	PC

Refer to the following sub-sections for specific instructions and criteria for connecting the cables.

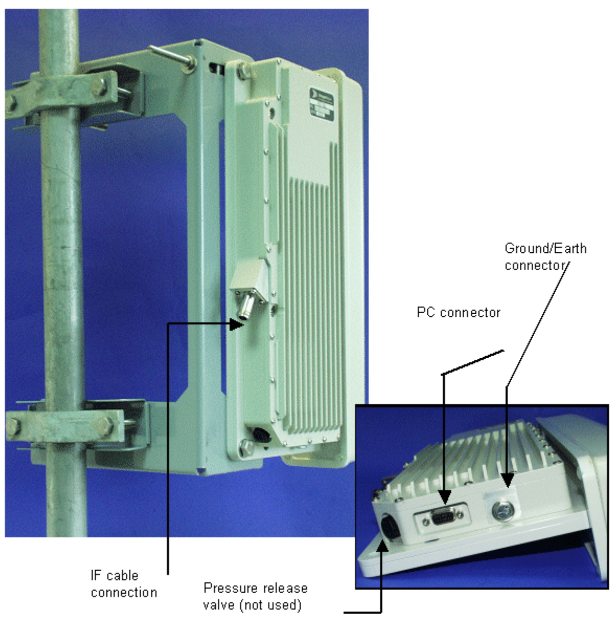


Figure 5-13: Connecting the BS 28 GHz ODU

Connecting the Ground/Earth Cable

To connect the 28 GHz BS ODU ground/earth cable:

- Referring to Figure 5-13, connect the ground/earth cable to the BS ODU.

Connecting the IF Cable

To connect the 28 GHz BS ODU IF cable:

- Referring to Figure 5-13, connect a single coaxial cable between the ODU and the IDU IF MUX.

  For a cable length greater than **150m**, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB regardless of its length.

- Refer to Figure 5-14. When routing the coaxial cable, leave a **service loop** at the RFU end to provide a sufficient length of cable to enable replacing faulty connectors, when necessary.

  Secure the coaxial cable so that there is no mechanical stress at the RFU connection. Follow the superstructure with the coaxial cable to its base, and then to the building. If the coaxial cable requires suspension from the base to the building, use a stranded wire to support the coaxial cable weight (This support will prevent a migration of the cable's inner conductor to the shield)

  Sealing the ODU Connector – See Sealing the ODU Connector.

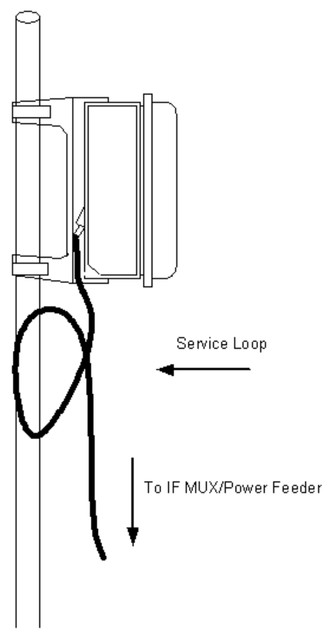


Figure 5-14: BS 28 GHz ODU Service Loop

CAUTION

The IF cable connector must be a certified outdoor connector.

The outdoor connectors should be tightened using shrink sleeves.

6

Chapter 6 - Base Station IDU Installation

In This Chapter:

Overview

The following elements may be part of a **BS IDU**:

- **BS-SA** – provides interface to the backbone and to the RF equipment
- **IF-MUX 2** – used to implement *two carriers* per sector configuration
- **IF-MUX 4** – used to implement configurations of up to *four carriers* per sector (including Alvarix topology) and ODU redundancy.
- **E1-Switch** – used to implement IDU redundancy

NOTE: The number and type of elements in the indoor and outdoor equipment varies depending on the site topology.

BS-SA Description

The BS-SA is a stackable, 1U high unit that can be installed in rack, mounted on a wall, or simply placed on a flat surface such as a desk. It provides the following functions:

- Connection to 10/100BaseT IP/Layer 2 backbone
- Interface to E1 SDH backbone
- Base-band to IF signal conversion
- Local and remote management capabilities of the BS-SA and the TSs that it hosts.

Power is provided by a dedicated -48 VDC power source.

Several BS-SA models corresponding to the various frequency bands are available: **10.5 GHz**, **26 GHz** and **28 GHz**.

Views, LEDs and Connections

The following figure shows the BS-SA front view. It is followed by tables describing the LEDs and interfaces.

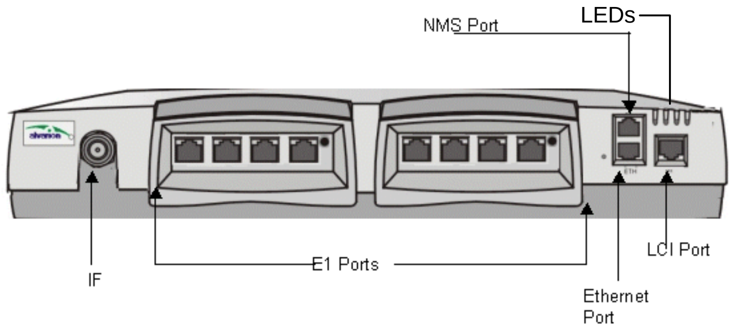


Figure 6-1: BS-SA Front View

BS-SA LED Description

The following table describes the BS-SA LEDs indications.

Table 6-1: BS-SA LED Descriptions

LED	Description
Internal	BS-SA internal elements (software, Services, Ports Etc.) condition : **Red** - Missing or uncalibrated IF Card; E1 or ETH Port down - *(blinking)* BS-SA not configured or disabled **Green** - Ethernet port is "UP" (when service is configured on this port) - *(blinking)* BS-SA SW download running **Yellow** - BS-SA SW download failed - BS-SA SW version switchover - BS-SA unauthorized access
External	Air link status: Red - Most TS radio link loss - (blinking) BS-SA not configured or disabled Green - All the radio links and all ports are "UP" Yellow - S radio link loss (less than 50%)
E1	E1 ports administration status and functionality
Ethernet	Ethernet Port administration status

Table 6-2: BS-SA Front Panel Interface Connectors		
Interface	**Type/Rate**	**Description**
8 x E1	RJ45	Each port provides the interface to a 2 Mbps channel.
1 x Ethernet Port	RJ45, 802.3 10/100 Base T	Ethernet interface
1 NMS Ethernet Port	RJ-45	Used for connection to WALKnet Network Management System.
LCI	RJ45	Provides an interface to a local craft terminal for management purposes.
IF Port	N-Type TX/RX -48 VDC	Provides the interface to the RFU.

The following figure shows the BS-SA rear panel with the power and ground connections. It is followed by a table describing the interface connections.

NOTE: The ventilation is on the rear panel. Be sure to allow enough space for proper air-flow during the installation.

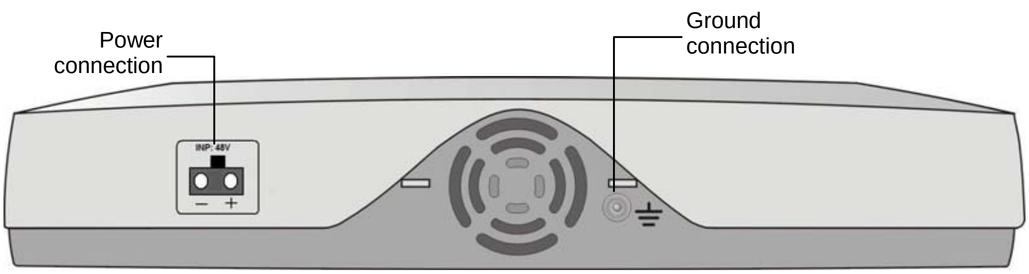
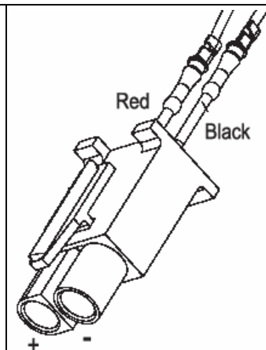
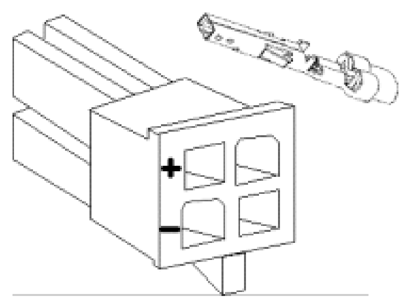


Figure 6-2:-BS-SA Rear View

NOTE: Some BS-SA may have a four pin power connector. Both types of power connectors are described in the following table.

Table 6-3: BS-SA Rear Panel Interface Connectors

Power - Nominal –48 VDC, Fuse protected (5 A)	Connector - Female 2-Pin Molex P/N 42179-2RI Pin for 16-18 AWG	
Power - Nominal –48 VDC, Fuse protected (5 A)	Connector - CN1068 Molex part number 39-01-2040	
Ground		Located on rear panel

Ground and Power Connections

To connect the BS-SA to ground:

Connect an earth cable to the grounding point on the rear panel of the BS-SA.

To connect the BS-SA to power:

Connect the –48 VDC power cable to the rear panel of the BS-SA.

Mounting the BS-SA

The BS-SA can be installed in any of the following configurations:

- Wall mounting
- Desktop mounting
- Rack mounting

Wall Mount

To mount the Terminal Station on a wall:

1. Turn the BS-SA upside down and locate the two wall mounting holes.
2. Measure the distance between the holes. Prepare the wall for mounting. It is recommended to use rawlplugs and screws.

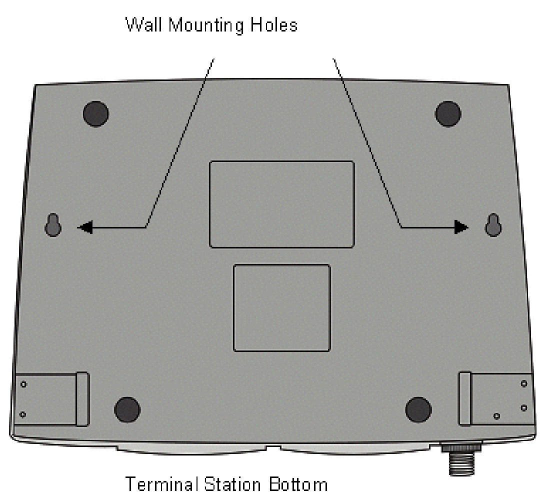


Figure 6-3: Terminal Station IDU Wall Mounting

Desktop Mount

The BS-SA comes with four miniature support legs for the desktop option. Attach the support legs and place on a clean, flat surface as shown in Figure 10-2.

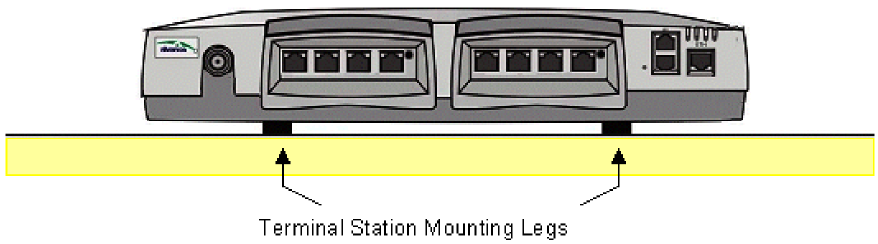


Figure 6-4: Desktop Mount

Rack Installation (19" or ETSI Racks)

The BS-SA can be installed in either an ETSI or 19" rack using horizontal mounting. The unit is supplied with rack mounting brackets suitable for installation in both rack types.

Before beginning the installation, verify that the rack is grounded in accordance with the local standards.

To install the BS-SA IDU on a rack:

1. Referring to the following figure:
   - Position the BS-SA upside down and slide the side brackets into place.
   - Insert the screws provided and secure them.
   - Turn the unit the right way up.

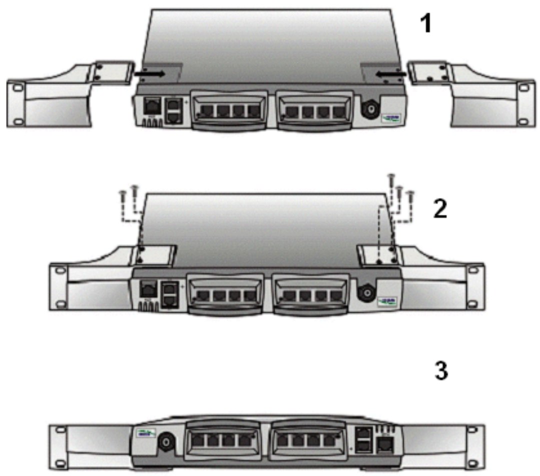


Figure 6-5: Installing Side Brackets

2. Referring to and Figure 10-3:
   - Fix the Terminal Station to the rack. Use the screws provided, two for each side bracket.

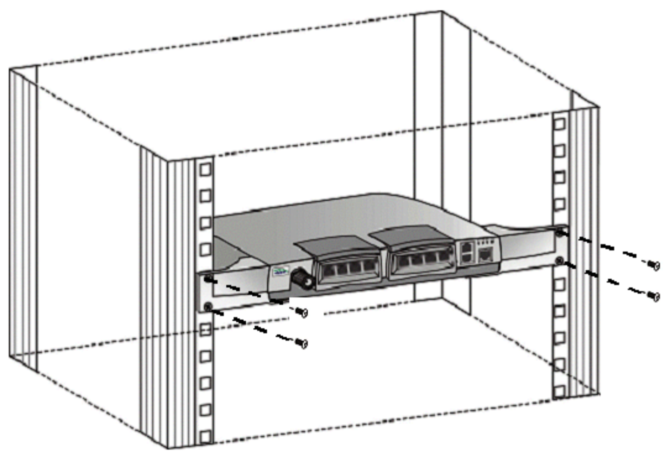


Figure 6-6: Fixing the Terminal Station to the Rack

Descriptions of Additional Devices

The devices described in this section are required to implement various configurations. For example, IF-MUX II and IF-MUX 4 are used to implement multi-carrier configurations and E1 switch is used to implement redundancy. The panels, LEDs and connections of each device is detailed.

IF-MUX II

IF-MUX II devices are used in two carrier configurations to multiplex the IF signal from two BS-SAs and feed the single signal to a single RFU.

NOTE: DC is acquired from only one of the BS-SA units (**In 2** + **DC port)**. If the BS-SA connect to **In 2 + DC** fails, then the RFU will not receive power. To overcome this possibility, it is recommended to connect an external power feeder.

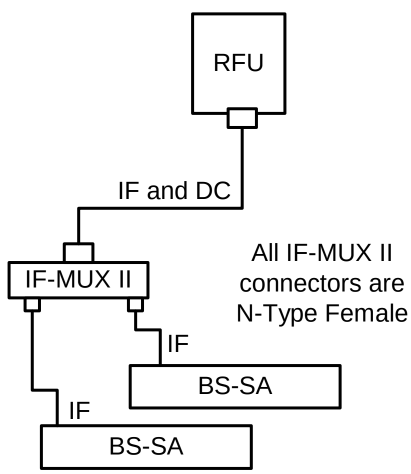


Figure 6-7: IF-MUX II

To connect the BS-SAs to an IF-MUX device

Connect the **IF** connector output on the **front panel of each BS-SA** to the IF connectors of the IF-MUX II.

NOTE: No power connections are required to the IF-MUX II

2-Port Power Feeder

The 2-Port Power Feeder supplies an external –48 VDC voltage to one or two RFUs.

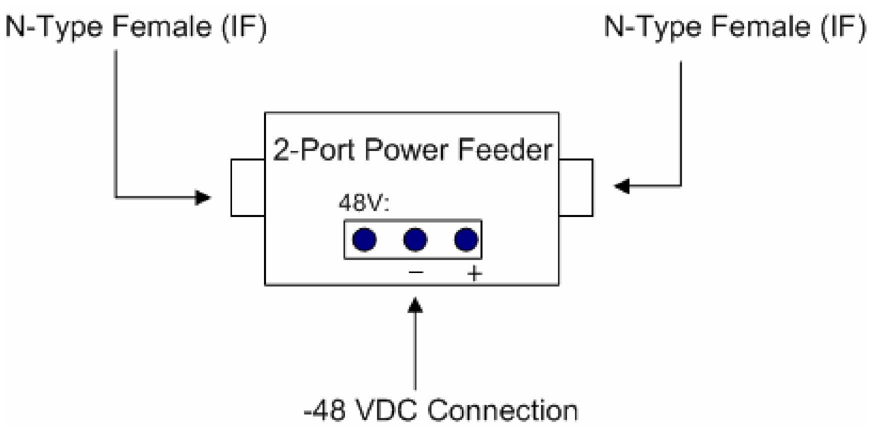


Figure 6-8: 2-Port Power Feeder

IF-MUX 4

NOTE: IF-MUX 4 is relevant to all frequency bands from 10.5 and 26 GHz (for Alvarix) to 28 GHz.

IF-MUX 4 is used to implement topologies of:

- Up to four carriers per sector (as opposed to two carriers per sector implemented using IF-MUX II)
- ODU redundancy – by supplying connections to two RFUs

NOTE: IF-MUX 4 requires a –48 VDC supply.

Front Panel

The IF-MUX 4 front panel contains the IF connections to the BS-SA (3000) and BS-BU (1000).

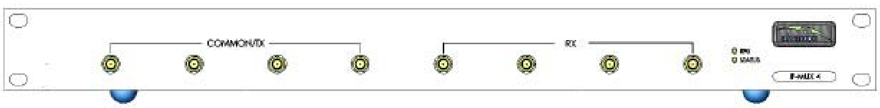


Figure 6-9: IF-MUX 4 Front Panel

Table 6-4: IF-MUX 4 Front Panel LED Descriptions

LED	Description
Status	Operational status of IF-MUX: OFF – power OFF. Green – device operational – OK Red – fault or error indication
RFU LED	RFU A and RFU B connection indication Green - RFU A power detected Orange - RFU B power detected

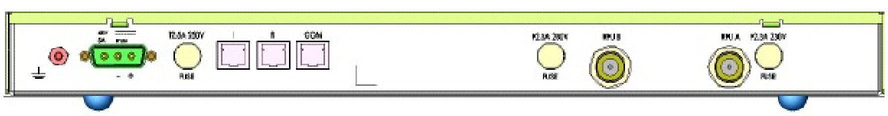
Table 6-5: IF-MUX 4 Front Panel Port Descriptions

Port	Description
COMMON/Tx	Four IF port connections. Each port can be connected to either the IF port of a BS-SA device or the Tx connection to a BS-BU 1000 device (the BS-BU Rx is connected to one of the Rx ports).
Rx	Four ports that provide the IF Rx connection for the 1000 BS-BU

Rear Panel

The IF-MUX 4 rear-panel contains the RF connection ports, RF redundancy control ports, the power connection and fuse locations.

NOTE: All fuses are (TBD)



3. Figure 6-10: IF-MUX 4 Rear Panel

Table 6-6: IF-MUX 4 Rear Panel Port Descriptions

Port	Description
RFU A and **RFU B**	Connection to RF (outdoor) unit(s) through a coaxial cable. RFU A – Master or default RFU connection. RFU B – standby RFU connection for redundancy configuration (in which both RFU ports are connected in addition to the **COM** port.)
COM	Control port – connects to the WALKair 3000 LCI port
I and R	WALKair 1000 BS-BU I and R connections
Power	Power input: 48VDC

E1 Switch

The E1-Switch provides redundancy capability to the BS-SA in terms of switching between up to 16 E1 lines from one BS-SA to another and controlling the IF-MUX 4 device.

The Master BS-SA determines switching between the BS-SAs. There is also a reference clock switch for the input clock. The output clock is derived directly from the input clock. The default port is A. E1-switch also monitors the communication channel between BS-SA and IF-MUX 4.

If a ‘Master request’ from the redundant BS-SA is detected, the E1 lines, reference clock and If-MUX 4 communication channel are switched to that BS-SA.

A ‘Keep alive’ messaging mechanism relays specific message to the redundant (standby or slave) BS-SA as backup to the Ethernet channel. If there are no ‘Keep Alive’ signals from the Master BS-SA for more than 30 seconds, a timeout is indicated and a RED LED is lit on the E1-Switch front panel.

Front Panel

The E1 switch front panel contains the backbone and network connections to the BS-SA units.

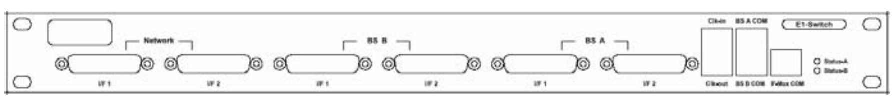


Figure 6-11: E1 Switch Front Panel

Table 6-7: E1 Switch LED Descriptions

LED	Description
Status-A	Green – BS-SA A is currently active Red – no message received from the BS-SA B for 30 seconds
Status-B	Green – BS-SA B is currently active Red – no message received from the BS-SA B for 30 seconds

Table 6-8: E1 Switch Front Panel Port Descriptions	
Port	**Description**
Network	Network interface to the E1 ports of the currently active BS-SA.
BS A	Connections to Master BS-SA E1 ports through the appropriate interface cables.
BS B	Connections to Stand-by BS-SA E1 ports through the appropriate interface cables.
Clk-in	Reference clock from network (for future support)
Clk-out	Based on **Clk-in**. (for future support)
BS A Com	Connection to BS-SA A **COM** (LCI connection) port
BS B Com	Connection to BS-SA B **COM** (LCI connection) port
IF-MUX Com	Connection to IF-MUX COM port

Rear Panel

The rear-panel contains the power connections, fuse and grounding.

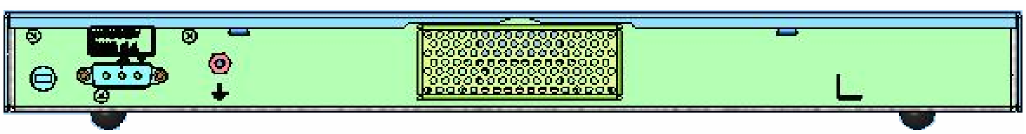


Figure 6-12: E1 Switch Rear Panel

Table 6-9: E1 Switch Rear Panel Port Descriptions	
Port	**Description**
Power	48VDC
Fuse	5A

Connections

The E1-Switch connects one IF-MUX 4 device and two BS-SAs: Master BS-SA and Standby BS-SA.

Each BS-SA is connected through two 8xE1 cables and one RS232 LCI cable. The IF-Mux 4 COM port is connected to the E1-Switch using a RS232 cable.

The E1-Switch unit is connected to the network, using two 8xE1 cables and clock in/out for system synchronization.

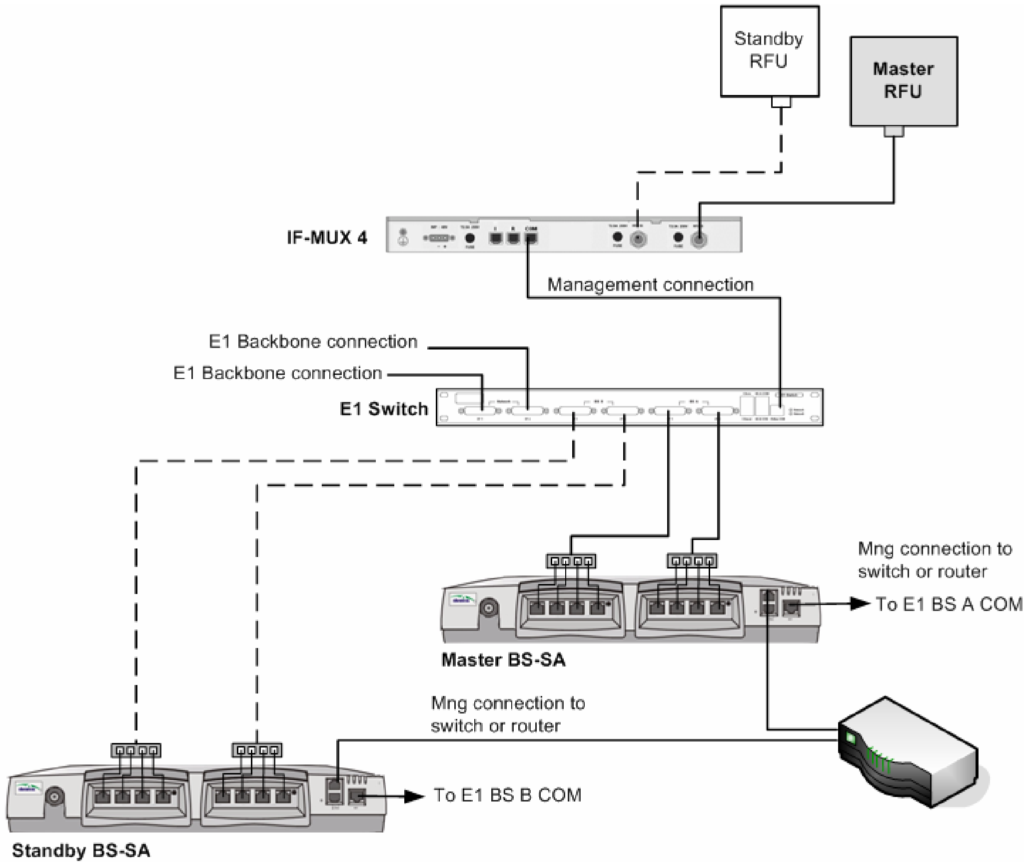


Figure 6-13. E1 Connections

Connections for Various Configurations

This section describes the connections for various configurations.

General Instructions

NOTE : This section describes only the **BS-SA IF** connections. The rest of the BS-SA connections (E1, Ethernet, NMS, power and ground) are described in the previous section.

The following instrucitons apply to all IF and RF connections :

- Prepare the IF cables according to IF Cable Installation, page 2-13.
- For the connections to the RFU, refer to the section **Connecting the Cables** in the relevant BS RFU section: 10.5/26/28 GHz.

One Carrier per Sector

This configuration is implemented by one BS-SA per RFU.

To connect one BS-SA to one RFU:

1. Connect all the BS-SA connections according to the instructions in Views, Connections and LED Descriptions, page 6-3.
2. Route and connect the IF cable between the **IF** connector on the **BS-SA rear panel** to the relevant IF connector on the RFU.

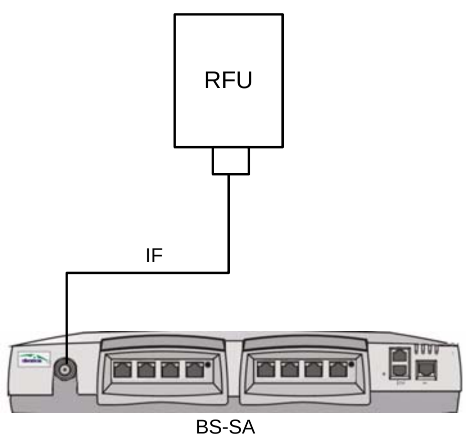


Figure 6-14: Single Carrier per sector configuration

Two Carriers per Sector

This configuration is implemented using two BS-SAs per RFU. An **IF-MUX II** device is used to feed the two carriers to a single RFU.

To connect two BS-SAs to one RFU:

1. Connect all the BS-SA connections according to the instructions in Views, Connections and LED Descriptions, page 6-3.
2. Route and connect the IF cables between the **IF** connectors on the **rear panel** of each **BS-SA** to the **IF** connectors on the IF-MUX II device.
3. Route and connect the IF cable from the **IF-MUX II** to the **RFU**.

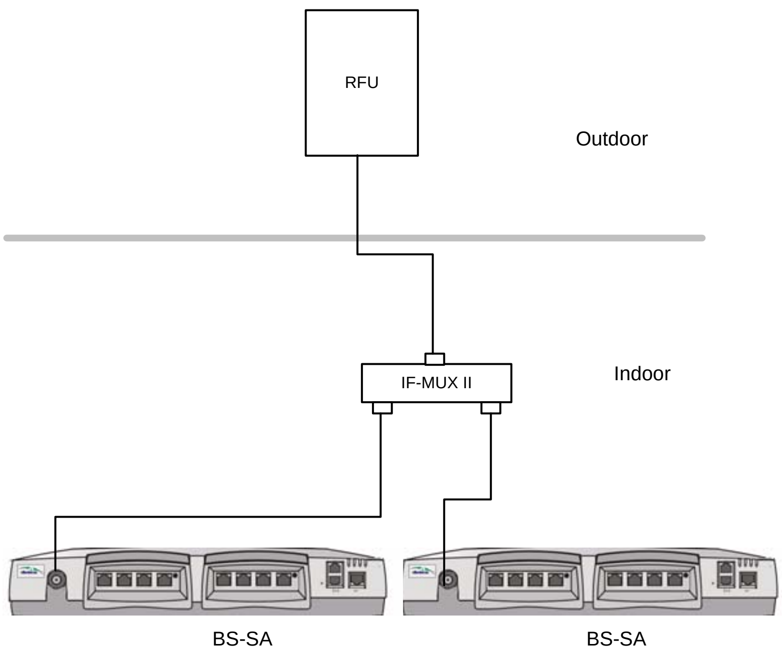


Figure 6-15: Two BS-SAs and one RFU

Up to Four Carriers (BS-SA only) per Sector

IF-MUX 4 is used to implement a configuration of up to four carriers per sector. The carriers may be implemented using:

- Only BS-SA 3000 devices - as described in this section;
- Only BS-BU 1000 – as described in the WALKair 1000 Installation Manual;
- A combination of both (Alvarix) – as described in the following section).

Connecting up to Four BS-SAs to one RFU

1. Connect all the BS-SA connections according to the instructions in Views, Connections and LED Descriptions, page 6-3.
2. Route and connect the IF cables between the **IF** connectors on the **rear panel** of each **BS-SA** to the **COMMON/Tx IF** connectors on the **IF-MUX 4** front panel.
3. Connect **48 VDC** to the IF-MUX 4 rear panel power connector.
4. Connect the **LCI** port of *any one of the BS-SAs* to the **IF-MUX 4** rear panel **COM** port.
5. Route and connect the IF cable from the **IF-MUX 4** rear panel **RFU-A** connector to the **RFU**.

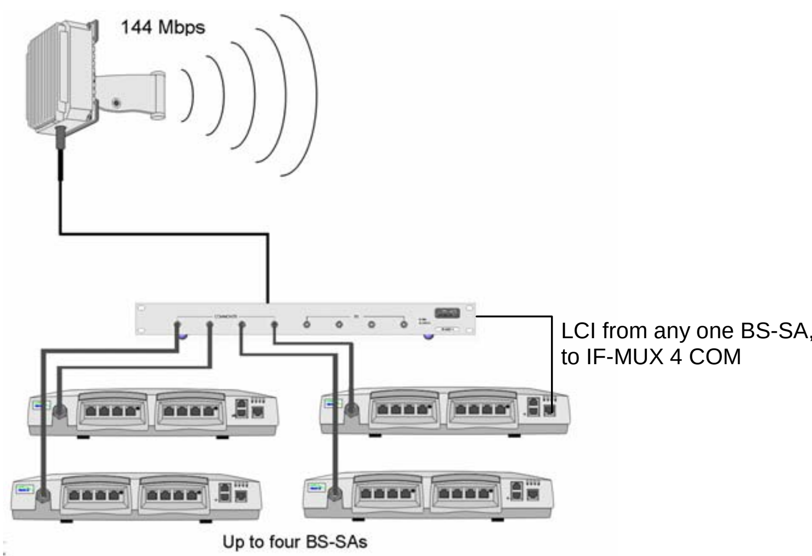


Figure 6-16: Four BS-SAs to One RFU

Alvarix

This section describes how to connect any combination of up to four BS-SA and BS-BU (1000) devices to a single RFU, providing four carriers per sector.

NOTE: Each BS-SA requires a single IF connection, while the BS-BU requires two IF connections: Tx and Rx. Four of the IF-MUX 4 IF ports (labeled as COMMON/Tx) serve as either BS-SA IF ports or BS-BU Tx ports.

1. Connect all the BS-SA connections according to the instructions in Views, Connections and LED Descriptions, page 6-3.
2. Route and connect the IF cables between the **BS-SA** rear panel **IF** connectors to the **IF-MUX 4** front panel **COMMON/Tx** ports.
3. Route and connect the **IF Tx** cables from the **BS-BU 1000** to the **IF-MUX 4** front panel **COMMON/Tx** ports, and the **IF Rx** cables from the **BS-BU 1000** to the **IF-MUX 4** front panel **Rx** ports.
4. Connect **48 VDC** to the IF-MUX 4 rear panel power connector.
5. Connect the **LCI** port of *any one of the BS-SAs* to the **IF-MUX 4** rear panel **COM** port (use the RJ45 pin-to-pin cable).
6. Route and connect the IF cable from the **IF-MUX 4** rear panel **RFU-A** connector to the **RFU**.

The following figure shows a three carrier configuration implemented by two BS-SAs and one BS-BU 1000. Note that the BS-BU 1000 requires two connections.

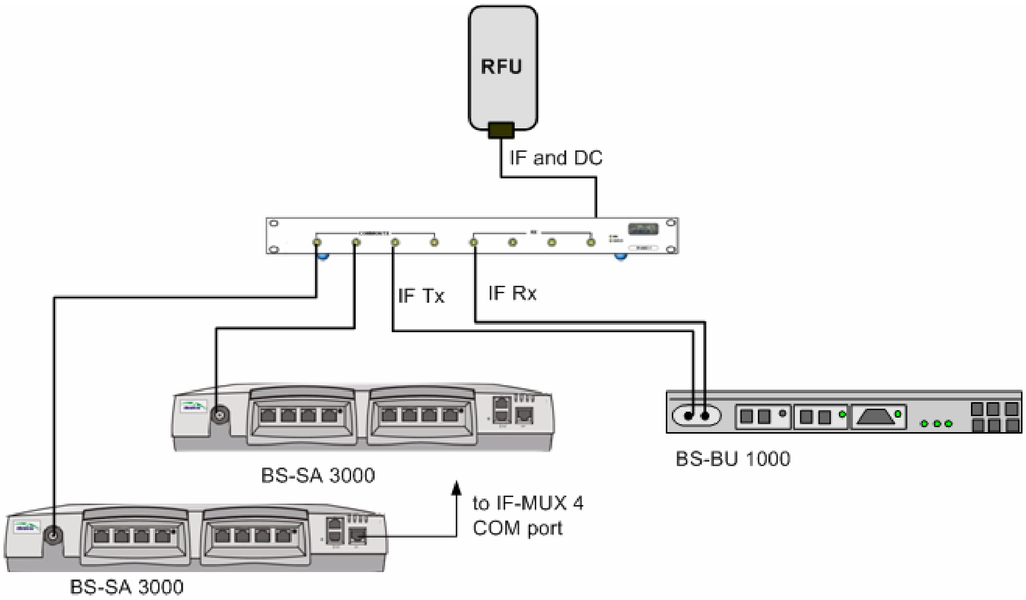


Figure 6-17: IF-MUX 4 Configuration

One Carrier per Two Sectors

This configuration is implemented by connecting a single BS-SA to two RFUs (the sectors should be exactly opposite and with different polarization). This configuration requires:

- **DE-MUX** device - used to feed the single carrier to two RFUs.
- **2-Port Power Feeder –** used to supply the additional power to support *two* RFUs. The power feeder requires a power connection.

NOTE: The DE-MUX device is weather proof and installed outdoors – near the RFUs to which it is directly connected.

To connect one BS-SA to two RFUs:

1. Connect all the BS-SA connections according to the instructions in Views, Connections and LED Descriptions, page 6-3.
2. Route and connect the **IF** cable from the **BS-SA IF** connector to the **2-port Power Feeder**.
3. Connect an **IF** cable between the **2-Port Power Feeder** to the **DE-MUX**, and from the DE-MUX to the RFUs.
4. Connect the IF cables from the **DE-MUX** to the **RFUs**.

NOTE: N-Type right-angled connector is supplied to ensure the cabling does not interfere with closing of the rack door.

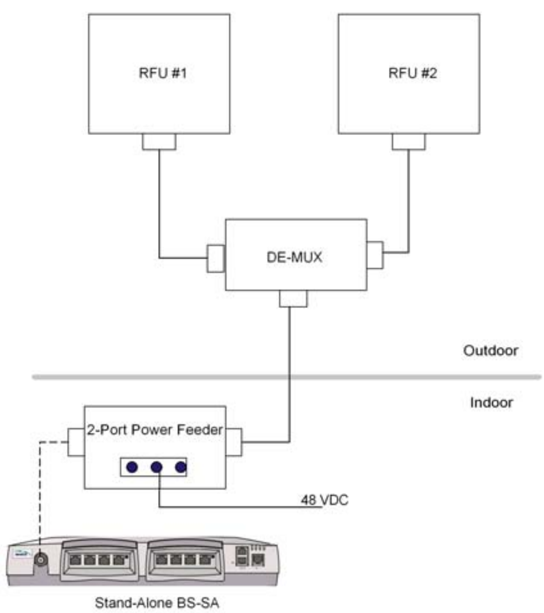


Figure 6-18: One BS-SA and two RFUs

Redundancy Connections

WALKair 3000 provides redundancy support for:

- RFUs
- BS-SA E1 connections
- Management - LCI management connection is backed-up by an Ethernet management connection

Redundancy is implemented through E1 Switch and IF-

RFU Redundancy

RFU redundancy is achieved by connecting two RFUs to the **RFU A/B** connections on the **IF-MUX 4** rear panel.

The Master and Standby units are automatically determined by the physical connection: the Master connections are the RF ***A*** connection to the IF-MUX 4.

1. Connect the IF connector of the RFU designated as the **Master**, to the **RFU A** connector on the IF-MUX 4 rear panel.
2. Connect the IF connector of the RFU designated as the **Standby**, to the **RFU B** connector on the IF-MUX 4 rear panel.
3. Connect the BS-SA **LCI** port to the **IF-MUX 4 COM** port.
4. Connect the BS-SA **IF** port to one of the **COMMON** ports on the IF-MUX 4 front panel.

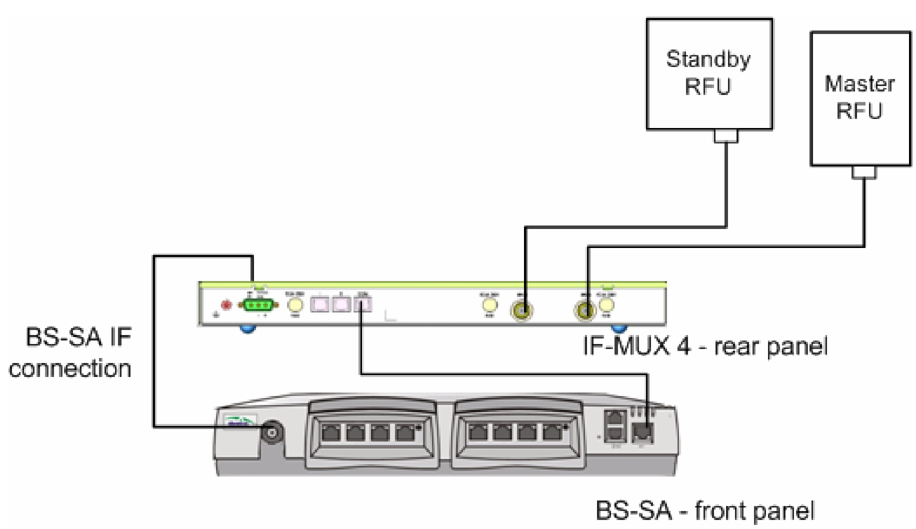


Figure 6-19. Example of RFU Redundancy Connections

BS-SA E1 Redundancy

BS-SA E1 redundancy is implemented by connecting the E1 connections of two BS-SAs to the E1 Switch.

1. **Master BS-SA connections:**
   - Using the supplied cables, connect the E1 ports of the BS-SA designated as the **Master**, to the **A** ports on the E1 Switch.
   - Connect the BS-SA **LCI** port to the E1 Switch **BS A COM**
   - Connect the BS-SA **Mng** port to an Ethernet router or switch.
2. **Standby BS-SA connections:**
   - Using the supplied cables, connect the E1 connections of the BS-SA designated as the **Standby**, to the **B** connectors on the E1 Switch.
   - Connect the BS-SA **LCI** connector to the E1 Switch **BS B COM**
   - Connect the BS-SA **Mng** port to an Ethernet router or switch.
3. Connect E1 Switch **Network** ports to the E1backbone.
4. Connect E1 Switch **COM** port to the Network.

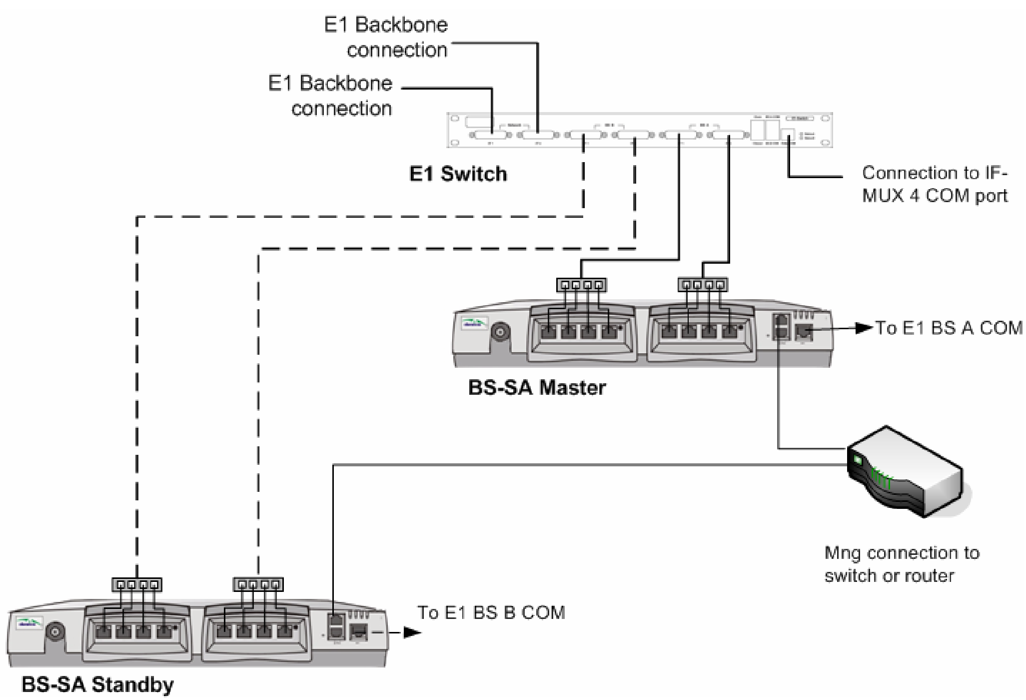


Figure 6-20: Example of E1 Redundancy Connections

E1 and RF Redundancy

To implement redundancy for the BS-SA and for RFUs, the following equipment is required:

- Two BS-SAs
- Two RFUs
- E1 Switch
- IF-MUX 4

Referring to the previous sections, interconnect the devices as illustrated in the following figure.

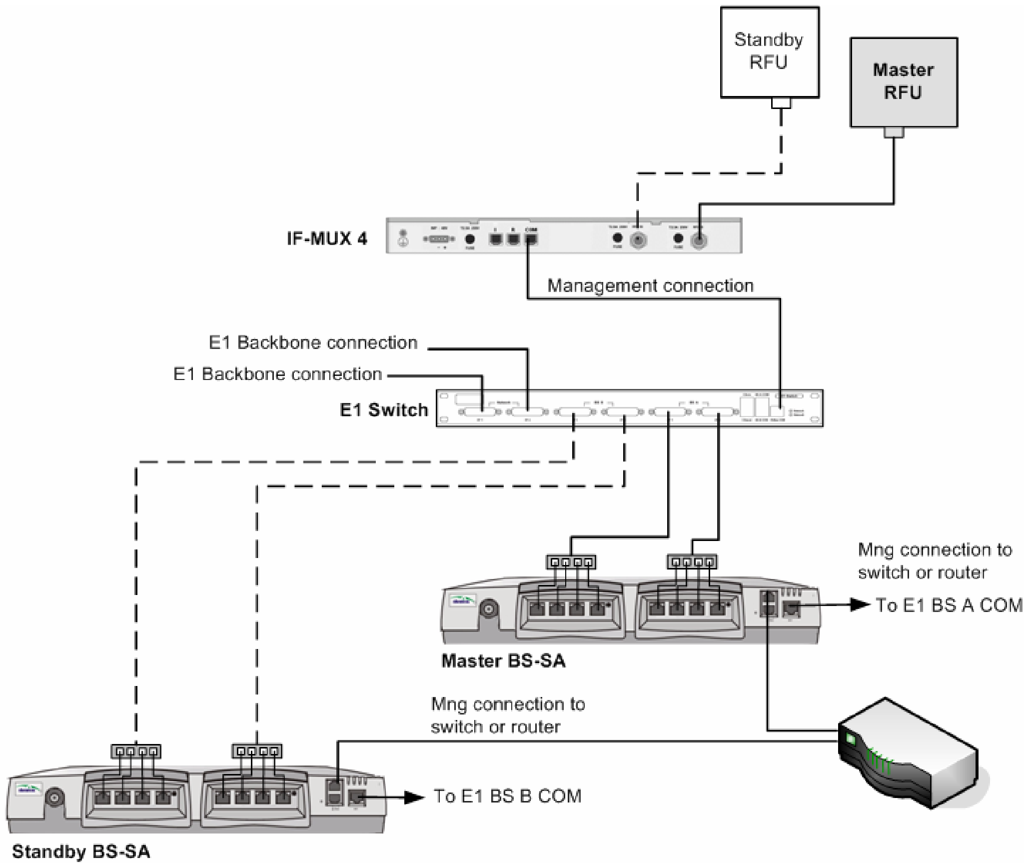


Figure 6-21: Example of E1 and RFU Redundancy Connections

RFU Redundancy in Alvarix

This section describes how to implement RFU redundancy in an Alvarix installation consisting of up to four BS-SA (3000) and BS-BU (1000) devices (in any combination).

General comments

The following explanations clarify the connections.

- The BS-SA and BS-BU (1000) units, as well as the Master and Standby RFUs are connected to an IF-MUX 4 device.
- **IF connections:**
    - Each **BS-SA** requires a single IF connection.
    - Each **BS-BU** requires two IF connections: Tx and Rx. Four of the IF-MUX 4 IF ports (labeled as COMMON/Tx) serve as either BS-SA IF ports or BS-BU Tx ports.
- **Redundancy information:**
    - BS-BU (1000) - transmits redundancy information through two ports: **I** and **R** connected to corresponding I and R ports on IF-MUX 4.

      NOTE: If more than one BS-BU is connected, the I and R port of the BS-BUs must be interconnected according to instructions in the WALKair 1000 Installation Manual.

    - BS-BU (3000) – transmits redundancy information through **LCI** connection of *one* BS-SA to IF-MUX 4 **COM** port

Connections

1. **BU IF connections:**
    - BS-SA IF connections: Route and connect the IF cables between the **BS-SA** rear panel **IF** connectors to the **IF-MUX 4** front panel **COMMON/Tx** ports.
    - BS-BU IF connections: Route and connect the **IF Tx** cables from the **BS-BU 1000** to the **IF-MUX 4** front panel **COMMON/Tx** ports, and the **IF Rx** cables from the **BS-BU 1000** to the **IF-MUX 4** front panel **Rx** ports.
2. **RFU Connections:**
    - Connect the IF connector of the RFU designated as the **Master**, to the **RFU A** connector on the IF-MUX 4 rear panel.
    - Connect the IF connector of the RFU designated as the **Standby**, to the **RFU B** connector on the IF-MUX 4 rear panel.
3. **RFU Redundancy information connections:**
    - **BS-SA:** Connect the **LCI** port of *any one of the BS-SAs* to the **IF-MUX 4** rear panel **COM** port (use the RJ45 pin-to-pin cable).

- **BS-BU:** referring to the WALKair 1000 Installation Manual, interconnect (chain) the I and R ports of the BS-BUs and then connect the I and R ports of the top BS-BU in the chain to the I and R ports of the IF-MUX 4 rear panel.

The following figure shows a three carrier configuration implemented by two BS-SAs and one BS-BU 1000. Note that the BS-BU 1000 requires two connections.

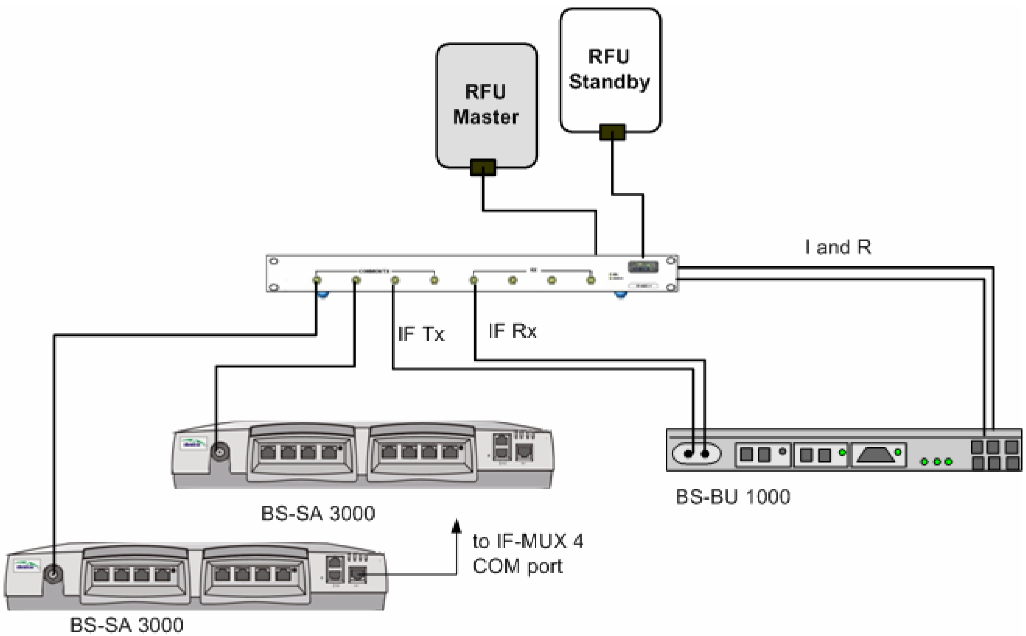


Figure 6-22: IF-MUX 4 Configuration

7

Chapter 7 - 10.5 GHz Terminal Station ODU Installation

In This Chapter:

Installation Guidelines

Follow these guidelines below to ensure proper and smooth installation:

- Never install the RFU near power lines.
- Assemble the RFU, bands and mounting adapter in a safe location before climbing up to the mounting location. Use caution when climbing, and when working at the mounting location.
- Make sure you have determined the best location for the RFU pole before mounting the pole. Make sure that you can route the IF cable from the location into the building.
- Before drilling any hole at the site building, make sure there are no electrical wires in the area of the holes.
- All installations should conform to the local building and electrical codes. If you are not sure, contact a licensed building inspector or electrician in your area to assist you. Be aware that community conventions, if any, may have additional requirements. Also, check your homeowner's insurance policy for any restriction or expectations that may apply.
- Choose a location that is easily accessible in most weather conditions for proper maintenance.
- Consider seasonal changes. The location may appear clear in the winter, but spring and summer foliage could dramatically attenuate the signal.
- If a tower/mast is already installed, we recommend installing the RFU-TS as high as possible to obtain the highest-quality power.
- Do not install the RFU at the top of the pole; always leave at least 40 cm space between the top of the pole and the RFU for better lightning protection.
- The RFU-TS and antenna must have a clear line-of-sight to the Base Station. Line-of-sight is defined as a first-order Fresnel zone that is clear of obstructions between the Base and the Terminal, including neighboring buildings, trees, power lines and other obstructions.
- Do not install the RFU where people can block its line of sight.
- Required clearance around TS antennas: To avoid frequency reuse problems caused by unwanted reflections, the main lobe of the antenna must be clear of any metallic objects for a range of up to 10 meters. In order to avoid the need to refer to particular antenna radiation patterns, the following criterion can be used: Clear metallic objects from a zone of up to 45 degrees to the right and left, and 45 degrees above and below, the antenna bore sight, for a distance of at least 10 meters, as shown below:

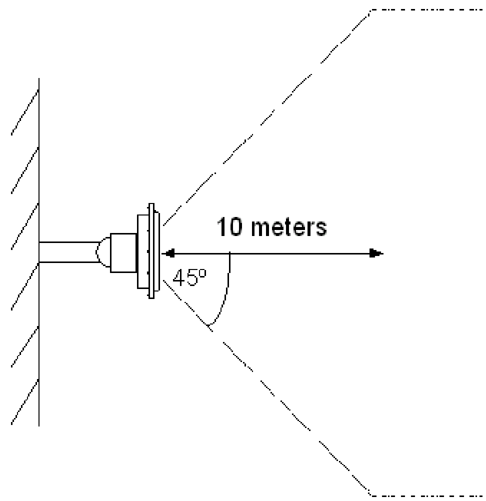


Figure 7-1: TS Antenna Clearance

- Wall-mount installation requires a 0.5-meter gap between the wall and the RFU. The permitted azimuth alignment limits are ±45° (angle α in Figure 7-1 above).
- The RFU-TS may be attached directly to the surface of the wall, with no gap in between, provided the wall is directly in front of the base station. When attaching the RFU-TS to a wall, azimuth is tolerated by no more than ±5° (angle β in the following figure).

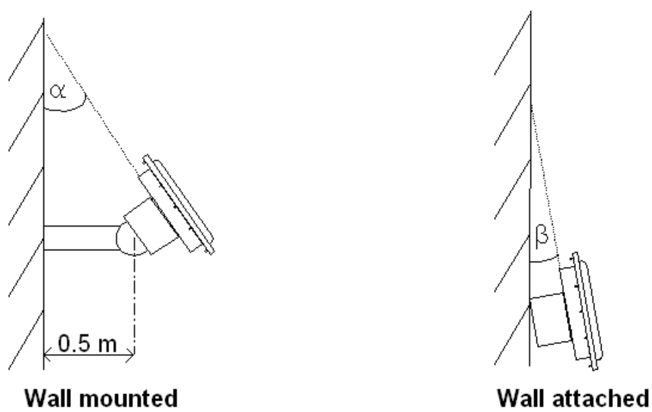


Figure 7-2: Mounting the RFU-TS on a Wall

We recommend installing the RFU-TS at the corner of the roof 0.5 meters above the railing, as described in the figure below. If the existing conditions do not match the rules of a specific area, install it according to the description in the above paragraph (see
Figure 7-2 above).

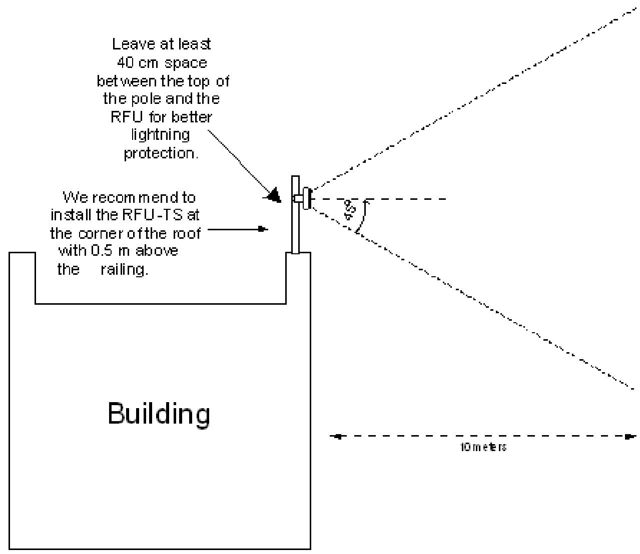


Figure 7-3: Installing the RFU-TS on the Roof Corner

NOTE: Installation on a roof corner is designed to overcome multipath problems arising due to proximity to a road.

If you are mounting it on the middle of the roof, we recommend installing the RFU-TS at least 2 meters above the lowest roof line (for example, the line of the railing can be taken as a reference line). Make sure that there are no walls or blocks in front the RFU on the roof.

- Before leaving the installation site, check that all hardware on the mount and antenna is secure.
- The antenna should be inspected at least once a year to check its condition and to ensure safe operation and maintenance. Qualified personnel, experienced in antenna installation, must perform this inspection.

Short Range Terminal

The 10.5 GHz RFU-TSs should be installed at least 300 meters from the base station. For shorter distances, use a short-range (50-500 meter) RFU. This short-range type of RFU has a different part number than the standard RFU, and requires setting the RFU head type in the TS-BU as Short Range.

10.5 GHZ TS ODU Specifications and Connections

The specifications of the integrated 10.5 GHz System antenna and RFU, are presented in the table below.

Table 7-1: 10.5 GHz Terminal Station Specifications

Item	Parameters
RFU + Antenna size (mm)	260x260x80
RFU + Antenna weight	4.3 kg
Antenna Beam width	8° vertical and horizontal

Figure 7-4 below shows the Terminal Station ODU cable connections:

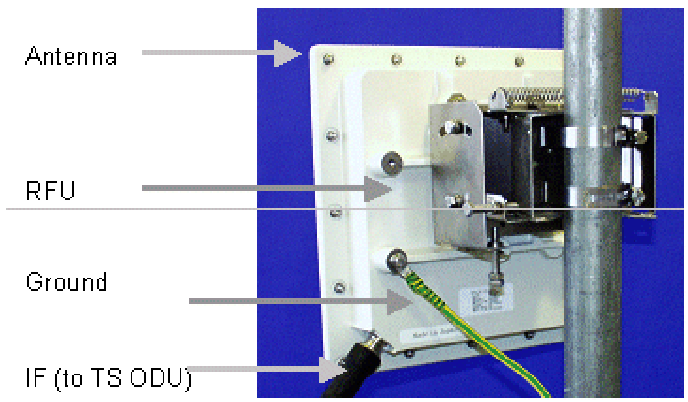


Figure 7-4: 10.5 GHz ODU Cable Connections

Installing and Mounting the 10.5 GHz TS ODU

Antenna Polarization

NOTE

The following instructions refer to a Terminal Station whose distance is farther than 300m from the Base Station.

For close Terminal Stations (less than 300m) refer to your local distributor for further instructions.

The 10.5 GHz unit supports both horizontal and vertical polarization using a mounting adaptor, without the need to disassemble and rotate the antenna.

The RFU/antenna is mounted on a mast with an adjustable mounting grip/bands. It can be oriented in either a horizontal or a vertical polarization.

The two figures below show the vertical and horizontal polarization of the antenna, from the front of the unit:

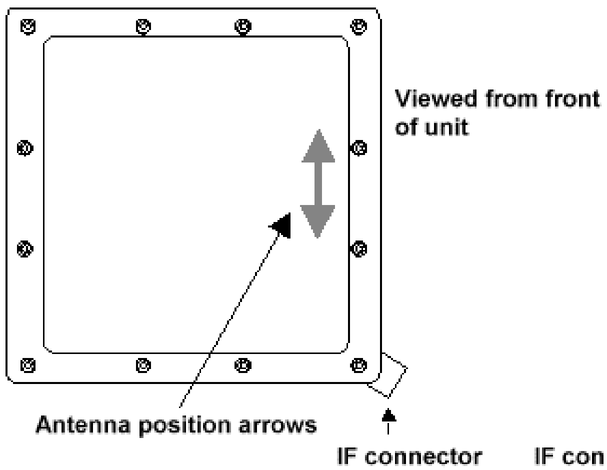


Figure 7-5: Vertical Polarization

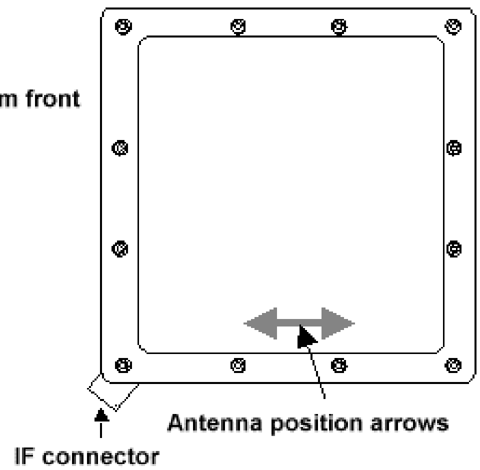


Figure 7-6: Horizontal Polarization

NOTE: Each polarization has a unique Part Number.

Before attaching the mounting grip/bands to the RFU/antenna, refer to the example figures below for antenna orientation (rear of the unit).

Figure 7-7: Vertical Polarization – rear of unit

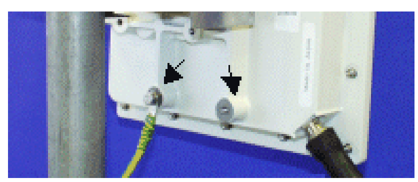


Figure 7-8: Horizontal Polarization – rear of unit

NOTE

Use the position of the grounding connections to determine the RFU/antenna polarization. Vertical grounding pins and a left IF cable connector indicates vertical antenna polarization; horizontal grounding pins and a right IF cable connector indicates horizontal polarization. See the pictures above for more information.

NOTE

Use the position of the grounding connections to determine the RFU/antenna polarization. Vertical grounding pins and a left IF cable connector indicates vertical antenna polarization; horizontal grounding pins and a right IF cable connector indicates horizontal polarization. See the pictures above for more information.

One of two alternative mounting kits may be provided for mounting the 10.5 Terminal Station ODU: **MD – 0087** or **MD – 1022**. The following two sections describe these mounting kits.

MD - 0087 Mounting Kit

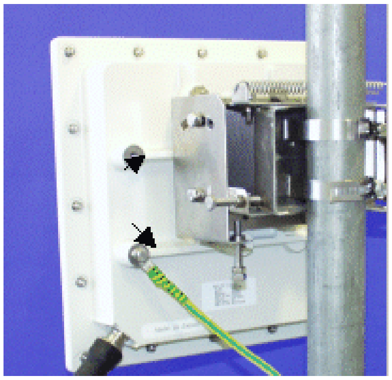


Figure 7-9: Vertical Polarization

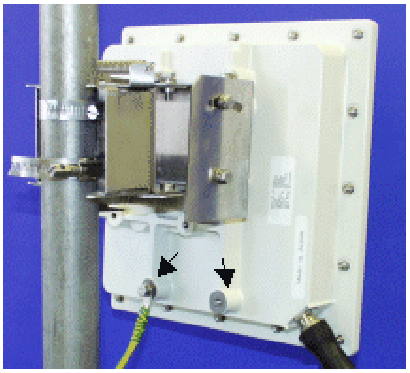


Figure 7-10: Horizontal Polarization

To install and mount the 10.5 GHz ODU (mounting kit MD – 0087):

1. Open the packaging and remove the mounting adapter.
2. For a square adapter, insert the two bands in the designated slots.
3. Place the RFU upside down on a clean surface (with the antenna panel facing down). For Vertical polarization, the RF connector must be in the bottom left corner, and for Horizontal polarization, the RF connector must be in the bottom right corner.
   Refer to Antenna Polarization on page 7-5 for the correct polarization.

4. Place the mounting adapter on top of the RFU (located on the back of the antenna) with the spring on top, according to the polarization.
5. Connect the mounting adapter to the back of the RFU with four 10 mm screws.
6. Position the RFU on the mast, leaving at least 40 cm between the top of the pole and the RFU for better lightning protection. The mounting adapter slots/bands is designed to fit a wide range of poles/masts. The band will fit any mast up to 4.3 " diameter.
   The adjustable top bracket option is suitable for 3/4" to 3" poles/masts.
7. Tighten the bands or top bracket around the mast.
8. Slightly loosen all screws and adjust the tilt/elevation using the following screws:
   - To adjust the elevation, use the long screw located on the bottom of the adapter (1). When the elevation is properly set, tighten the two screws on both sides of the adapter (2).

- To adjust the azimuth, use the long screw located on the left side of the adapter (3). When the azimuth is properly set, tighten the two screws on the top and bottom of the adapter (4

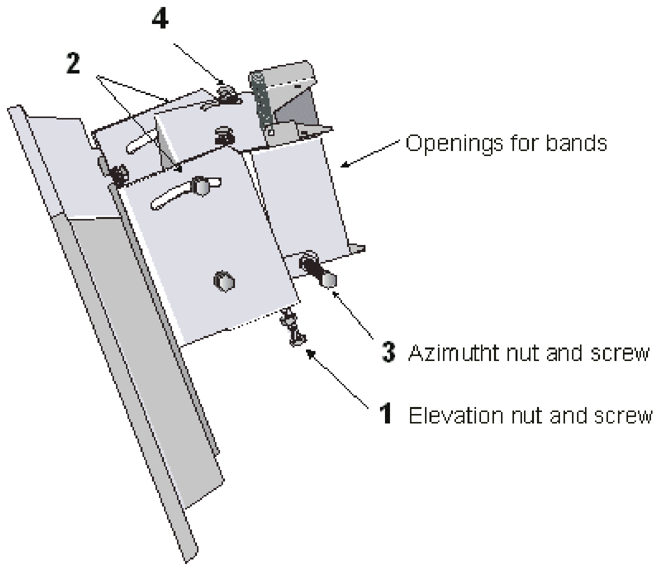


Figure 7-11: Adjusting the Tilt/Elevation

NOTE

Each ¼ turn of the azimuth /elevation screws is equivalent to 0.5o (½ degree). The azimuth adjustment range is 20o, and the elevation adjustment range is ±21o (total of 42o).

9. To adjust the elevation, turn the antenna on the axis screw that joins the cross adapter base to the bottom bracket.
10. Ground the RFU to the mast using the grounding connections (M6 diameter) located at the back of the RFU/antenna.
11. Seal the IF cable connection to the RFU to prevent water drainage.

Aligning the 10.5 GHz ODU Using the AAU

AAU Overview

The Antenna Alignment Unit tool (AAU) is a convenient, compact, water-resistant tool, designed to simplify installation of the WALKair 1000 Terminal Station's (TS) RFU + Antenna. This is achieved by providing audio and visual indications of the received signal strength.

The AAU functions as an IF receiver that allows precise, yet easy alignment of the TS antenna towards the Base Station (BS) antenna.

AAU Functionality

The AAU is connected between the Indoor-Outdoor cable and the RFU. This provides a mechanism for measuring the received signal strength at the Terminal Station's RFU, enabling the installer to determine the best alignment of the TS's RFU/Antenna.

The RX Signal Strength (RSS) is detected at the IF level. This is indicated via an audio tone, detected through an earphone, and a visual indication on the AAU.

The AAU supports 3.5 GHz, 10.5 GHz and 26 GHz frequency bands, which are selected prior to activation.

AAU Specifications

The AAU has two indicators, visual (an analog dial) and audio (via an earphone). When the received signal is strong, the needle on the visual indicator moves to the right, and a louder tone is audible in the earphone.

The following table lists the AAU specifications:

The following table describes the specifications for the AAU.

Table 7-2: AAU Specifications

Specifications	Description
Power Control:	On/Off
Frequency Selection:	Thumb switch to set the received frequency
Indications:	Audio or Visual
Received Gain:	To adjust the received signal strength
Power	The AAU uses 48 VDC nominal from the TS BU via the Indoor-Outdoor cable and feeds the RFU.
Size	L x W x H = 25 x 12 x 6 cm.
Water Immunity	AAU complies with IP62 – water splash (IEC 529)
AAU Frequency Bands support	26 GHz sub-bands A through H are supported with a single set of 64 IF channels (AAU index f24-f87) 10.5 GHz band is supported with a single set of 85 IF channels (AAU index f0-84) as shown in Annex 1.

AAU Dials and Controls

The following figure shows the AAU dials and controls.

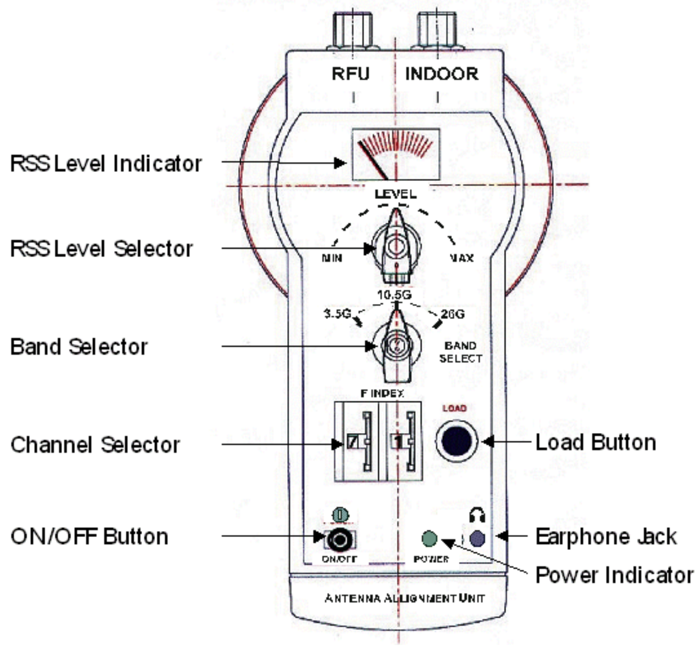


Figure 7-12: Antenna Alignment Unit (AAU)

The following table describes the AAU control functions.

Table 7-3: AAU Control Functions

Controls	Description
RSS Level Indicator	Shows the Rx Signal Strength
RSS Level Selector	Adjusts the offset level of the AAU
Band Selector	Selects which of the available bands is being used
Channel Selector	Selects the IF channel to be used
ON/OFF Button	Powers on the AAU
Load Button	Loads the IF Index with the channels to be used
Earphone Jack	Plugs the earphone connection into the AAU
Power Indicator	Indicates if power is on (Green)

AAU Installation Pre-requisites

Before connecting the AAU, ensure that the following prerequisites apply:

- The BS-BU is commissioned and the sector is transmitting.
- The TS-BU is installed and powered ON.

The IF cable is installed and connected to the TS-BU.

Connecting the AAU

To connect the AAU to the TS RFU:

1. Install the TS RFU with the antenna attached, and direct it in the approximate direction of the BS. Verify that the radio link is commissioned and active.
2. To use the AAU, disconnect the Indoor-Outdoor cable from the TS RFU, and connect it to the AAU Indoor connector.
3. Connect the power cable (part of the AAU kit) to the TS RFU. After the AAU is connected from the cable to the TS RFU, it is ready to detect the RSS.

   The AAU can now be used to make fine adjustments to the alignment. The following figure shows AAU to TS IDU connection.

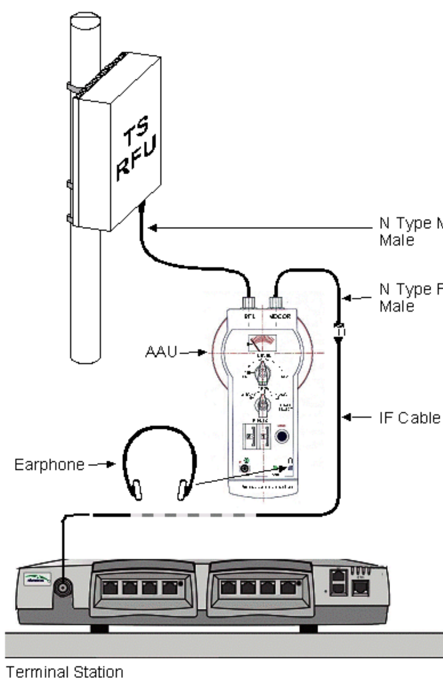


Figure 7-13: Connecting the AAU

Detecting the RSS

To activate the AAU and detect RSS:

1. Turn on the AAU.
2. Select the RF band and the AAU Index channel. See index conversion tables Table 3-8.
3. Press the LOAD button.

   The AAU is now operational and the indicator reflects the measured RSS.

NOTE: The selected channel should be one that is transmitted by the sector of this Terminal Station. A conversion table is used so that the selected channel reflects the desired RF frequency.

To detect the optimal RSS:

1. Point the antenna in the approximate direction of the Base Station, so that the RSS is strong enough to be detected by the antenna and the RFU.
2. Fine-tune the antenna azimuth by aligning it in the direction of the strongest received signal.

NOTE

If the indicator shows a weak signal, rotate the antenna until the signal gets stronger. Continue turning the antenna until optimal reception is achieved.

After passing the optimal point, the signal gets weaker. The installer should now turn the antenna back in the opposite direction until the optimal point is reached again.

If the received signal is too weak or too strong, the needle of the visual indicator will not point to the center, and detection of the optimal point will be difficult.

Use the Level Selector to adjust the offset level so that the detection of the optimal point is clear, and the needle is in the center.

3. After determining the optimal azimuth point, perform the previous steps in this procedure once again to tune the elevation.

NOTE

It is recommended to verify the azimuth alignment again after aligning the elevation.

Aligning the 10.5 GHz Antenna Using a Compass

Aligning the TS antenna using the compass takes into account the original azimuth of the Base Station and calculates a new azimuth that is 90o to the Base Station. The idea is to align the outer frame of the antenna so that it is more in line with the new azimuth, which will achieve greater accuracy.

Required Tools

- Compass
- Binoculars

To align the TS antenna:

1. Identify the Base Station location and azimuth using the compass and the binoculars.
2. To achieve greater accuracy, add or subtract 90o to/from the Base Station azimuth, depending on whether you are looking from the left or the right side of the antenna.
3. Using the compass, align the outer frame of the antenna to the newly calculated azimuth so that the antenna's flat surface faces the Base Station, as shown in the following figure.

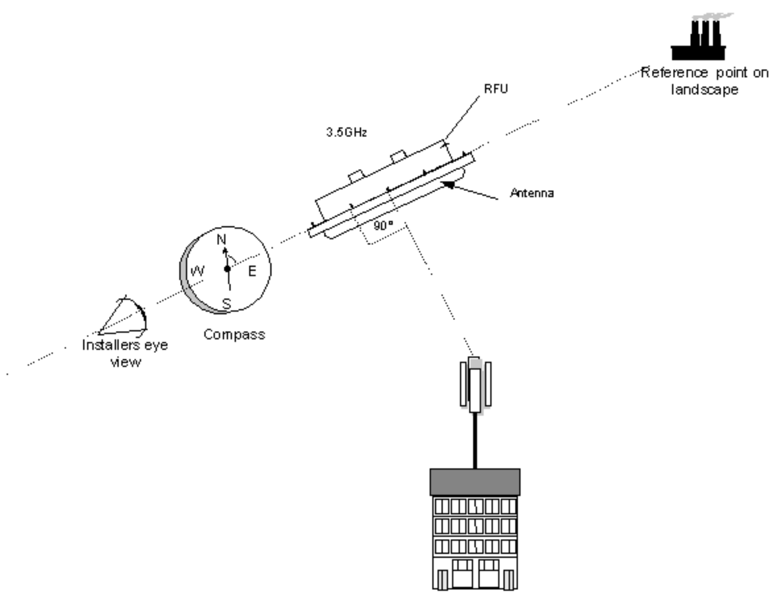


Figure 7-14: TS Antenna Alignment

Possible Interferences

Generally, large reflecting surfaces in parallel or partly in the beam, will cause reflections of the radio signal. For example:

- Metal/glass building
- Moist earth
- Water
- Above ground metals (like poles and telephone lines)

If you have a clear line-of-sight as defined above, the effect of this interference will be minor.

NOTE: Avoid installing near reflecting objects.

8

Chapter 8 - 26 GHz Terminal Station ODU Installation

In This Chapter:

This chapter includes:

Unpacking Guidelines

To unpack the TS system, follow these steps:

1. Carefully cut the sealing tape with a box cutter and open the box.
2. Remove the cardboard packing, any foam packing material, and protective plastic.
3. Compare the packing list with the items you received. If the items on the packing list do not match the items received, notify your Alvarion's representative.
4. Save the shipping cartons for reuse.

Installation Guidelines

CAUTION

Never install the RFU near power lines.

Before drilling any hole at the site building, make sure there are no electrical wires in the area of the holes.

Assemble the RFU, bands and mounting adapter in a safe location before climbing up to the mounting location. Proceed with extreme caution when climbing, and working at the mounting location.

Before leaving the installation site, check that all hardware on the mount and antenna is secure.

All installations should conform to the local building and electrical codes. If you are not sure, contact a licensed building inspector or electrician in your area to assist you.

Be aware that community conventions, if any, may have additional requirements.

Check your homeowner's insurance policy for any restrictions or exceptions that may apply.

The antenna must be inspected at least once a year to check its condition and to ensure safe operation and maintenance.

Qualified personnel must perform antenna inspection

Observe the above cautions and the guidelines below to ensure a proper and smooth installation:

- Make sure you have determined the best location for the TS-RFU pole before mounting the pole. Make sure that you can route the IF cable from the location into the building.
- Choose a location that is easily accessible in most weather conditions for proper maintenance.
- Consider seasonal changes. The location may appear clear in the winter, but spring and summer foliage could dramatically attenuate the signal.
- Do not install the TS-RFU where people can block it.
- The TS-RFU and antenna must have a clear line-of-sight to the Base Station. The TS-RFU must be mounted so that the line-of-sight is clear of neighboring buildings, trees, power lines and other obstructions.
- If you are mounting the TS-RFU on the middle of the roof, it is recommended to install the TS-RFU at least 2m above the lowest roofline (for example, the line of the railing can be taken as a reference line). Make sure that there are no walls or blocks in front of the RFU on the roof.
- If you need to mount the RFU on the wall of a building, you must ensure that the RFU-TS will be at least 0.5m away from the wall and no less than 15m above the ground as shown in Figure 8-1.

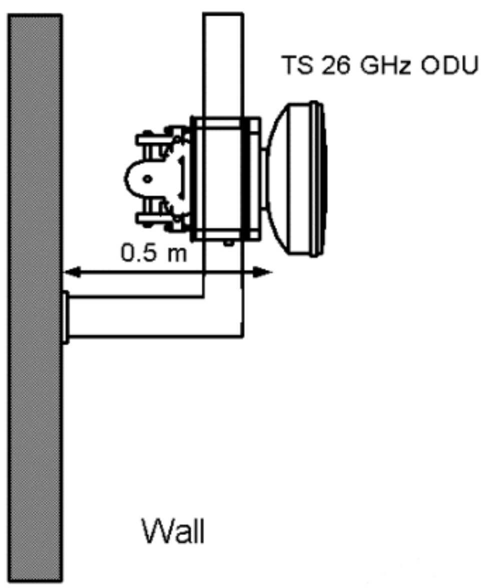


Figure 8-1: Mounting the RFU on a Wall

- Do not install the RFU at the top of the pole; always leave at least 40 cm space between the top of the pole and the RFU for better lightning protection (see Figure 8-2).

- It is recommended to install the TS-RFU at the corner of the roof 1m above the railing and no less than 15 m above the ground (see Figure 8-2). If the existing conditions do not match the rules of a specific area, install it according to the previous guideline.

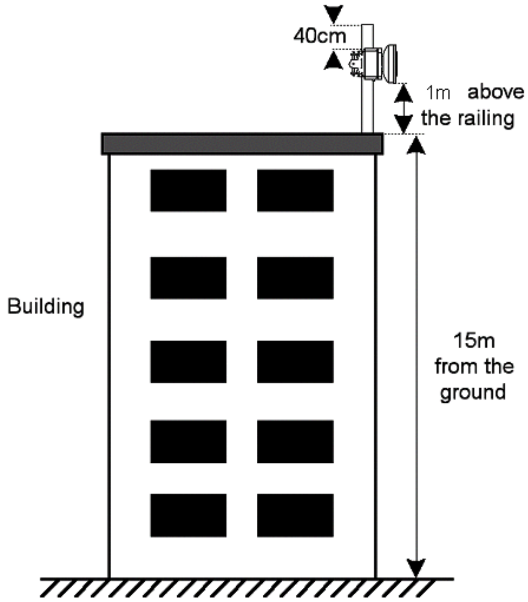


Figure 8-2: Installing the RFU-TS on the Roof Corner

Short Range Terminal

The 26 GHz RFU-TSs should be installed at least 300 meters from the base station. For shorter distances, use a short-range (50-500 meter) RFU. This short-range type of RFU has a different part number than the standard RFU, and requires setting the RFU head type in the TS-BU as Short Range.

Tools Required for Installation

Tools required for installation are as follows:

- Cross screwdriver
- Flat head screwdriver
- Adjustable wrench

Table 8-1 provides the recommended tightening torques for nuts used on stainless steel bolts, galvanized bolts or any bolts without the AST "A325" marking on the head.

Table 8-1: Recommended Tightening Torque

Nominal Bolt Size (inches)	Nut Torque		
1/4	50 IN-LBf	0.57 KGf-m	5.65 N-m
5/16	102 IN-LBf	1.175 KGf-m	11.52 N-m
3/8	15 FT-LBf	2.07 KGf-m	20.33 N-m
7/1	24 FT-LBf	3.32 KGf-m	32.54 N-m
1/2	37 FT-LBf	5.11 KGf-m	50.16 N-m

Installing a Terminal Station 26 GHz ODU

The mounting brackets described in this section support both horizontal and vertical antennas.

NOTE: All the illustrations in this section depict a 1.5” pole diameter. For larger diameters, the azimuth adjustment bracket should be installed in a reverse position.

Table 8-2 describes the recommended tightening torque for nuts used on stainless steel bolts, U-bolts, galvanized bolts or any bolts without the AST “A325” marking on the head.

Table 8-2: Recommended Tightening Torque

Nominal Bolt Size (inches)	Nut Torque		
¼	50 IN-LBf	0.57 KGf-m	5.65 N-m
5/16	102 IN-LBf	1.175 KGf-m	11.52 N-m
3/8	15 FT-LBf	2.07 KGf-m	20.33 N-m
7/16	24 FT-LBf	3.32 KGf-m	32.54 N-m
½	37 FT-LBf	5.11 KGf-m	50.16 N-m

Tools Required

- Cross head screwdriver
- 9/16” socket or wrench

- ½” wrench
- Torque meter

Installing a Terminal Station 26 GHZ ODU with a Vertical/Horizontal Mounting Adapter includes:

- Mounting the Terminal Station 26 GHz ODU on this page
- Adjusting the Terminal Station 26GHz ODU Antenna on page 8-13
- Connecting the Cables, on page 8-16
- Inspection before leaving the site on page 8-18.

Mounting the Terminal Station 26 GHz ODU

Mounting the Terminal Station 26 GHz ODU includes (in sequence):

- Installing the Azimuth adjustment plate, on this page
- Installing the Pole mount plate assembly, on page 8-8
- Installing he Elevation adjustment plate, on page 8-8
- Installing the TS 26 GHz ODU RFU Mounting Bar, on page 8-10
- Attaching the RFU to the Mounting Adapter, on page 8-12.

Installing the Azimuth Adjustment Plate

To install the azimuth adjustment plate

1. Attach the azimuth adjustment plate (P/N 101488-1) to the mast as shown in Figure 8-4. Use the U-bolt (100441-1), flat washer (WF38.SS-1), split lock washer (WS38.SS-1) and 3/8” x 16 bronze nuts (NH38-16.SB-1).
2. Align the plate so that the antenna will face the required direction (install the plate on the pole opposite to the antenna).
3. Attach the pole mount plate assembly to the mast (see Figure 8-3) using the two pole clamps (101459-1) and four 3/8” x 16 x 6.0 galvanized bolts (101585-600), galvanized split washers (WS38-GV-1), galvanized flat washers (WF38-GV-1) and 3/8” x 16 galvanized hex nuts (NH38-16GV-1).

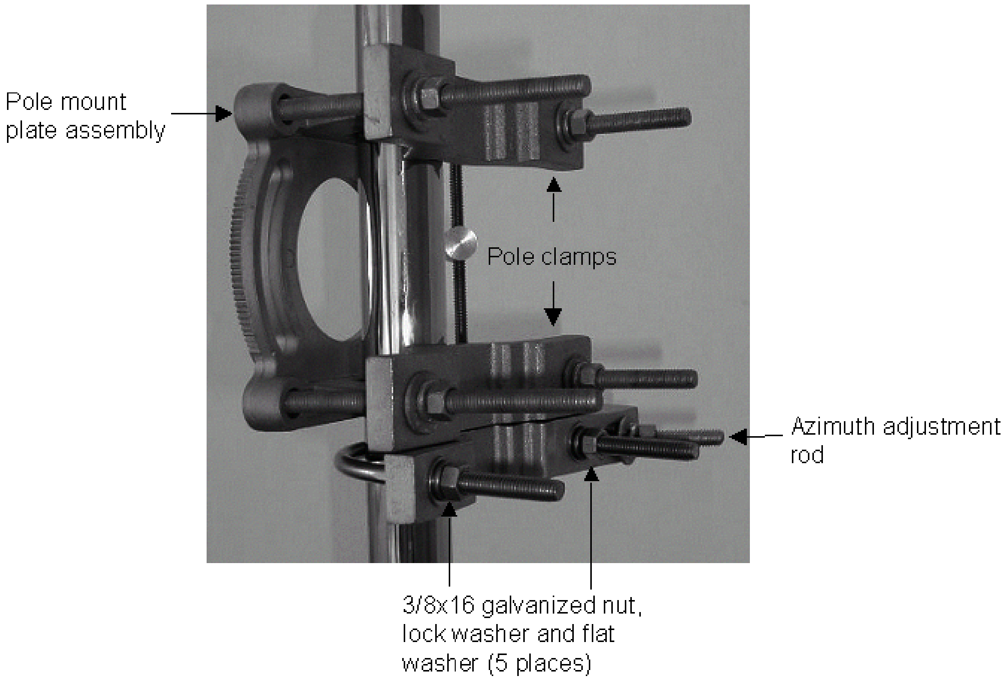


Figure 8-3: Pole Mount Plate

4. Fully tighten the nuts so the azimuth adjustment plate is secured to the mast.

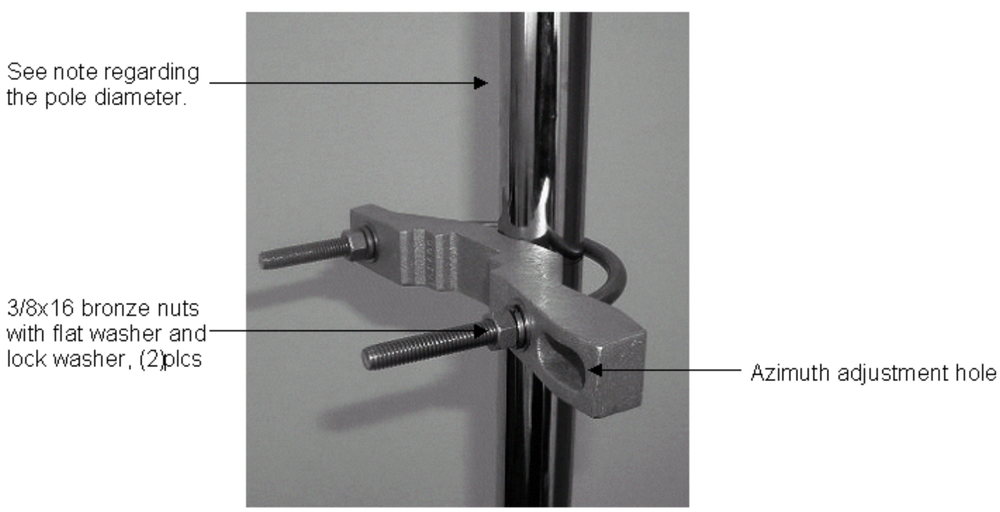


Figure 8-4: Azimuth Adjustment Plate

Installing the Pole Mount Plate Assembly

To install the pole mount plate assembly:

1. Position the pole mount plate assembly against the mast directly opposite the azimuth adjustment plate as shown in Figure 8-3.
2. Remove the 3/8” hex nut and the flat and split lock washer attaching the azimuth adjustment rod to the pole mount plate assembly, and slip the rod into the azimuth adjustment hole of the azimuth adjustment plate (see Figure 8-3).

NOTE

The azimuth adjustment rod is shipped from the factory attached to the pole mount plate.

CAUTION

At this time, do not completely tighten the two 3/8” x 16 nuts.

Installing the Elevation Adjustment Plate

To install the elevation adjustment plate:

NOTE

The elevation adjustment plate allows the antenna to be tilted up or down, as shown in Figure 8-5.

1. Attach the elevation adjustment plate (101487-2) to the antenna mount, as shown in Figure 8-5. Use five ¼” – 20 pan head screws (SP14-20.09) and split lock washers (WS14.SS-1).
2. Fully tighten the screws to the proper torque.

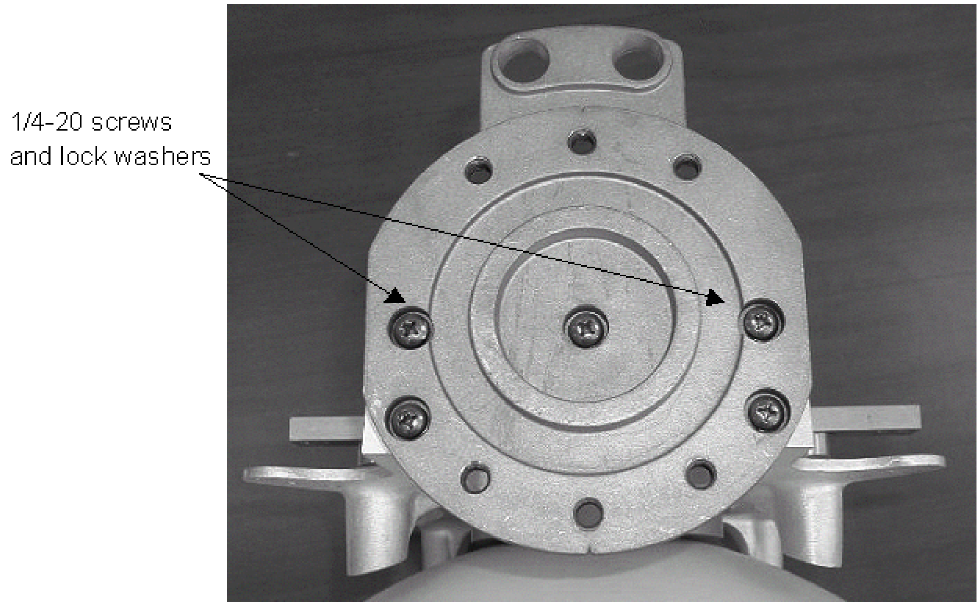


Figure 8-5: Elevation Adjustment Plate

3. Align the large diameter hub on the elevation adjustment plate to the pole mount plate and insert the brass rod into the elevation adjustment hole as shown in Figure 8-6.
4. Attach the two plates using two of the four screws, but do not tighten them. The screws should be inserted in the middle screw sockets (see Figure 8-6) and should be used with the SS flat washers, split lock washers, nylon washers and hex bolts as shown in Figure 8-7.
5. Align the brass rod in the pole mount plate with the desired elevation adjustment hole.

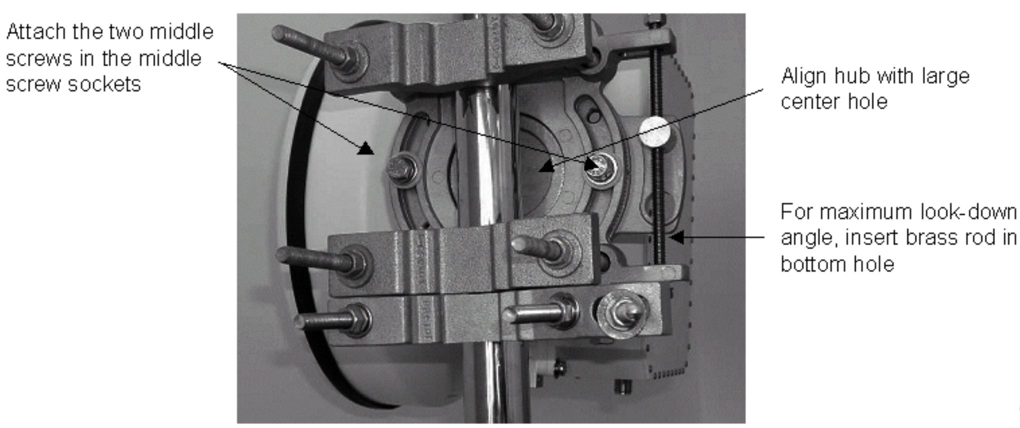


Figure 8-6: Elevation and Mount Assembly

6. After choosing the maximum look-up or look-down angle, attach the two assemblies together using the other two hex bolts (the other two hex bolts used in the middle screw socket).
7. Tighten the bolts so the hardware sits snugly against the pole, but do not tighten them fully, as shown in Figure 8-7.

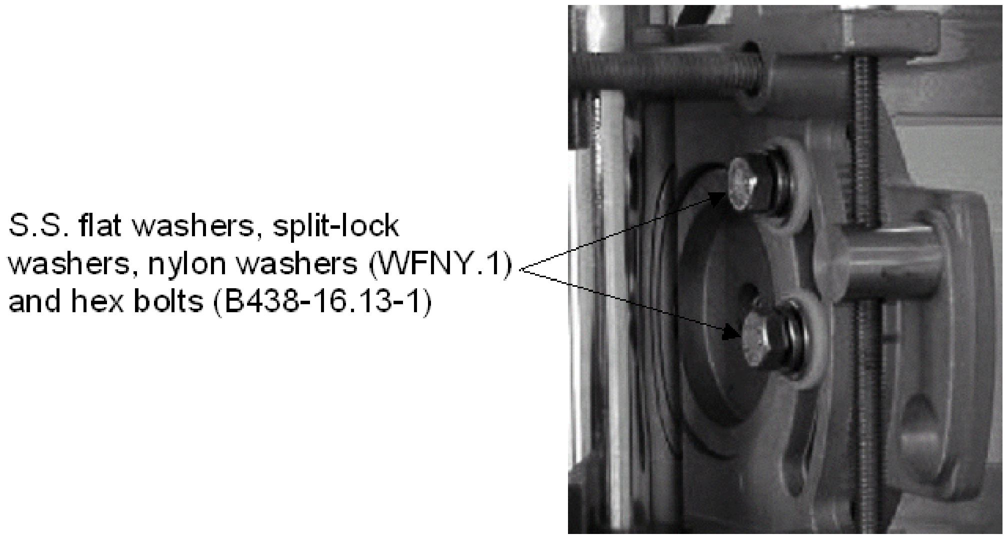


Figure 8-7: Elevation and Mount Assembly

Installing the TS 26 GHz ODU RFU Mounting Bar

Vertical Polarization

For vertical polarization, attach the RFU mounting bar to the antenna flange using the screw slots that are furthest from the marking dots as shown in Figure 8-8.

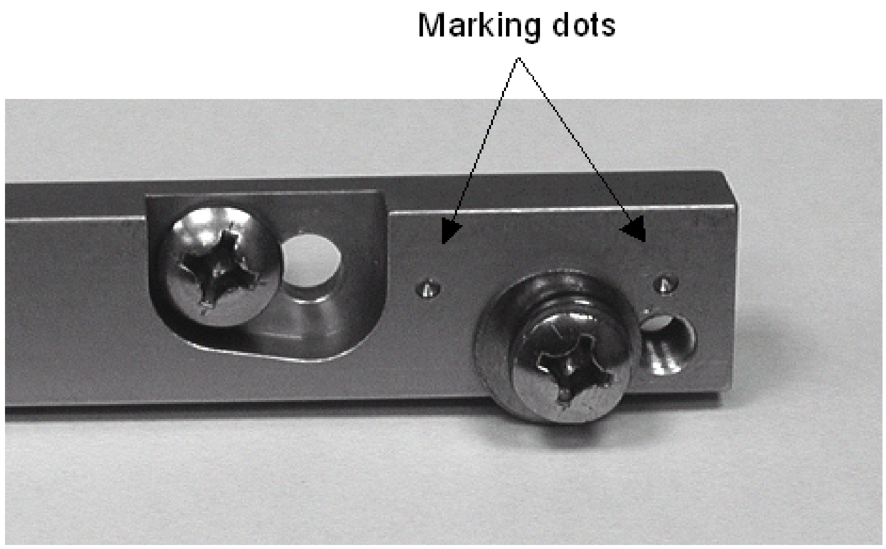


Figure 8-8: Marking Dots

Horizontal Polarization Installation

For horizontal polarization, attach the RFU mounting bar to the antenna flange using the screw slots that are closest to the marking dots.

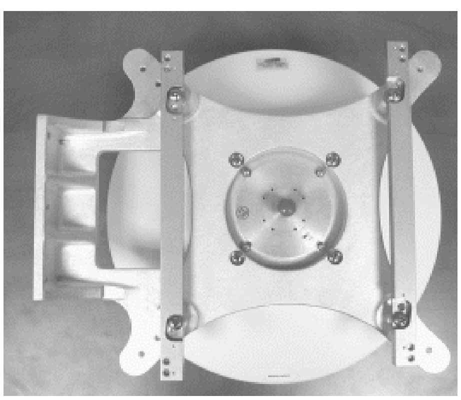


Figure 8-9: Vertical Polarization Installation

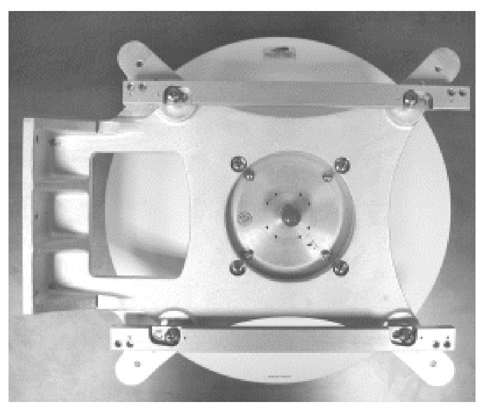


Figure 8-10: Horizontal Polarization Installation

NOTE

Whenever you disassemble the RFU mounting bars to switch polarization, make sure you replace the four spacers properly as shown in Figure 8-11.

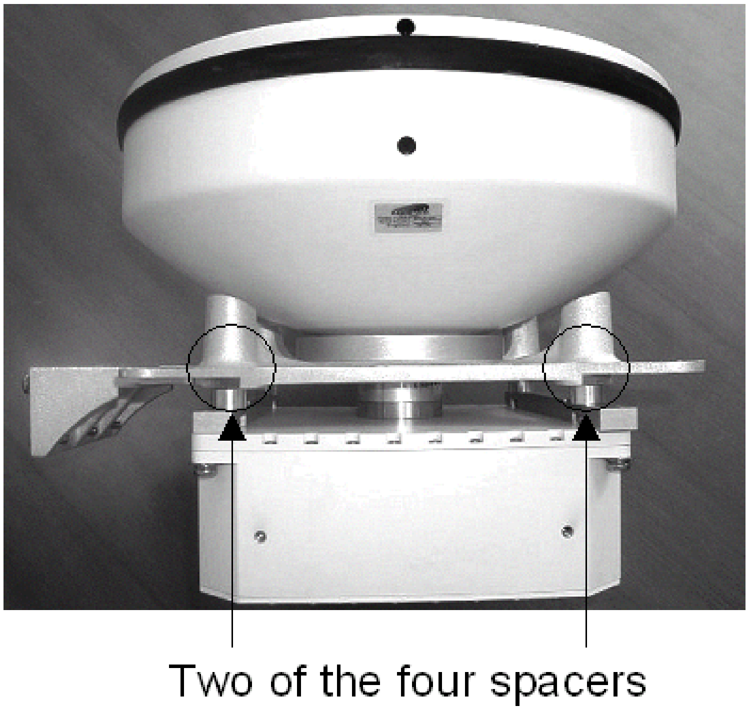


Figure 8-11: Spacers Location

Attaching the RFU to the Mounting Adapter

To attach the RFU to the mounting adapter:

1. Before you attach the RFU to the mounting adapter wave-guide, make sure that the round extra adapter is attached to the RFU.
2. Attach the RFU to the mounting bar according to polarization as shown in Figure 8-9 and Figure 8-10.

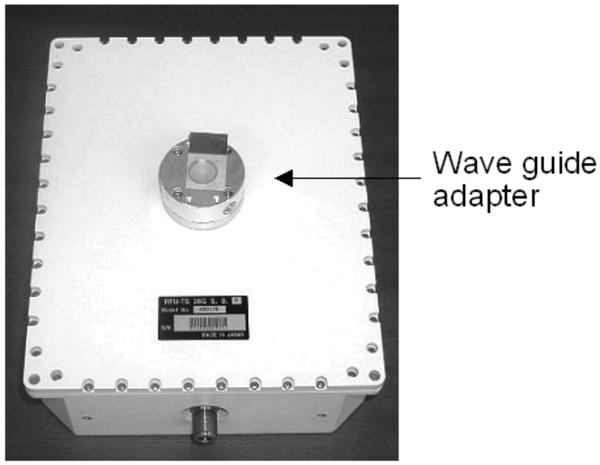


Figure 8-12: RFU Adapter

Adjusting the Terminal Station 26GHz ODU Antenna

Adjusting the Terminal Station includes:

- Adjusting the antenna azimuth clockwise, on this page
- Adjusting the antenna azimuth counterclockwise, on this page
- Adjusting the antenna elevation, on page 8-15

NOTE

See also optional Terminal Station Antenna Alignment using the AAU on page 8-18.

Adjusting the Antenna Azimuth Clockwise

To adjust the antenna azimuth clockwise:

1. Using either a 9/16” wrench or an adjustable wrench, loosen the two inside 3/8” – 16 galvanized hex nuts on the azimuth adjustment rod as shown in Figure 8-13.
2. To rotate the antenna clockwise around the pole, tighten the outer 3/8” – 16 hex nut on the adjustment rod until the antenna is in the desired position.

Adjusting the Antenna Azimuth Counterclockwise

To adjust the azimuth counterclockwise:

1. Using either a 9/16" wrench or an adjustable wrench, loosen the 3/8" – 16 galvanized nut on the azimuth adjustment rod, as shown in Figure 8-13.
2. To rotate the antenna counterclockwise around the pole, tighten the inner two 3/8" – 16 hex nuts on the adjustment rod until the antenna is in the desired position.

CAUTION

Remember to fully tighten the two inside nuts and the four hex nuts on the pole mount clamp to the proper torque specification when the adjustment is complete.

Fine azimuth adjustment allows for ±10 degrees.

Be careful to tighten the pole clamps evenly to avoid creating a gap between a clamp and the pole.

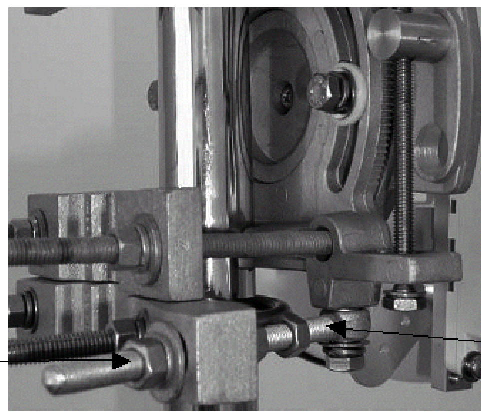


Figure 8-13: Fine Azimuth Adjustment

Adjusting the Antenna Elevation

To adjust the antenna elevation:

1. To adjust the look-up angle, using a ½" wrench or an adjustable wrench, rotate the elevation adjustment rod (as shown in Figure 8-14) counterclockwise to the desired position.
2. To adjust the look-down angle, using a1/2" wrench or an adjustable wrench, rotate the elevation adjustment rod (as shown in Figure 8-14) clockwise to the desired position.

CAUTION
Remember to fully tighten the four 3/8" – 16 bolts on the elevation adjustment plate to the proper torque specification, using a 9/16" wrench. Fine elevation adjustment allows for ±25º.

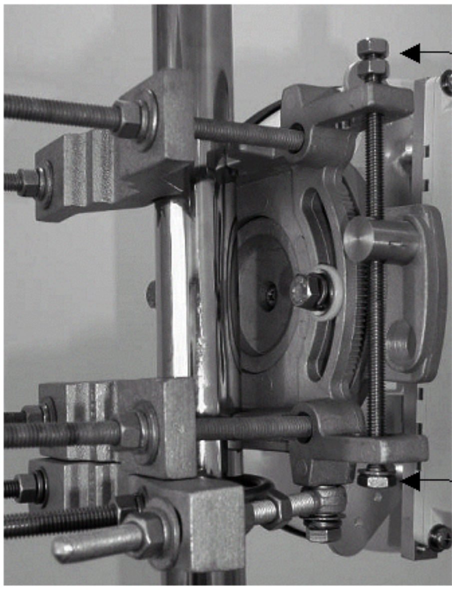


Figure 8-14: Fine Elevation Adjustment

3. Check the fine azimuth adjustment. If necessary, repeat the *Fine Azimuth Adjustment*, and recheck the fine elevation until the antenna is aligned correctly.

CAUTION
Before leaving the installation site, check that all the hardware on the mount and antenna has been fully tightened.

Connecting the Cables

Table 8-3 and Figure 8-15 provide the details of the TS 26 GHz-ODU cable connections. Please notice that a single coaxial cable is connected between the TS-RFU and the TS-IDU. For a cable length greater than 150m, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB regardless of its length.

Table 8-3: 26 GHz ODU Cable Connections

Cable	Connector	From	To
COAX 50Ω	N-Type	RFU	IDU
Ground	M6 screw diameter	RFU	Ground

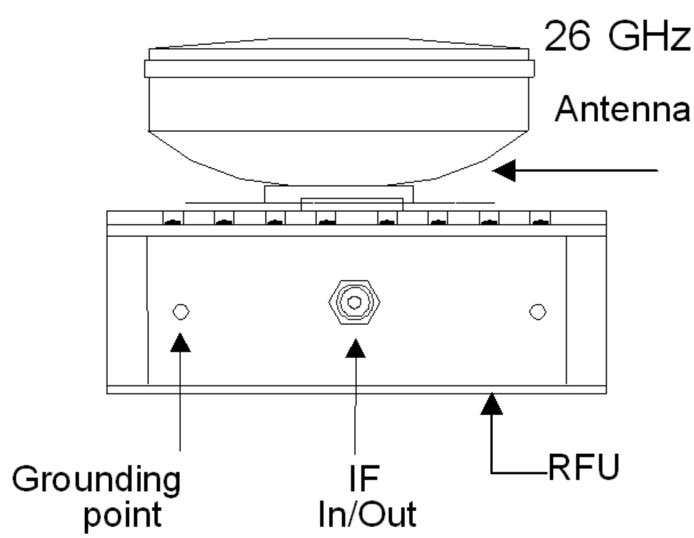


Figure 8-15: TS 26 GHz-ODU Cable Connections

Connecting the TS 28 GHz ODU Cables includes:

- Connecting the ground/earth cable
- Connecting the IF cable

Connecting the Ground/Earth Cable

connect the ground/earth cable:

- Referring to Figure 8-15, connect the ground/earth cable to the TS ODU.

Connecting the IF cable

To connect the IF cable:

- Referring to Figure 8-15, connect a single coaxial cable is between the ODU and the TS IDU IF connector. For a cable length greater than 150m, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB regardless of its length.
- At the RFU end of the cable, leave a Service Loop. Refer to Figure 8-16. When routing the coaxial cable, leave a **service loop** at the RFU end to provide a sufficient length of cable to allow replacement of a faulty connector, when necessary. Secure the coaxial cable so that there is no mechanical stress at the RFU connection. Follow the superstructure with the coaxial cable to its base, and then to the building. If the coaxial cable requires suspension from the base to the building, use a stranded wire to support the coaxial cable weight (This support will prevent a migration of the cable's inner conductor to the shield).
- Sealing the ODU Connector – See Sealing the ODU Connector.

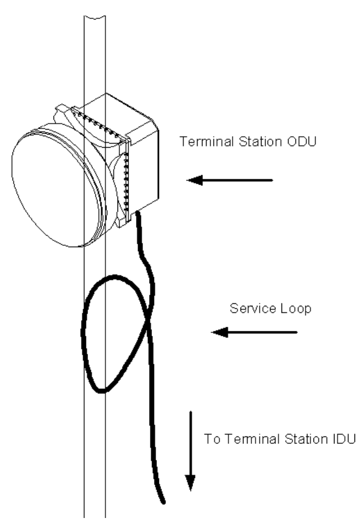


Figure 8-16: TS 26 GHZ-ODU Service Loop

CAUTION

The IF cable connector must be a certified outdoor connector.

The outdoor connectors should be tightened using sleeves.

At the RFU end of the cable, leave a Service Loop (see above).

Inspection and Routine Maintenance

CAUTION

Before leaving the installation site, check that all the ODU hardware on the mount and antenna are secure.

The antenna must be inspected at least once a year to check its condition and to ensure safe operation and maintenance.

Qualified personnel must perform antenna inspection.

Terminal Station Antenna Alignment Using the AAU (Fine Tuning)

For the description of the Antenna Alignment Unit (AAU) controls and functionality, refer to the AAU Manual.

Before connecting the AAU, ensure that the following prerequisites apply:

- The BS-BU is commissioned and the sector is transmitting.
- The TS-BU is installed and powered ON.
- The IF cable is installed and connected to the TS-BU.

Terminal Station Antenna Alignment using the AAU includes:

- Connecting the AAU
- Setting the AAU and detecting the RSS
- Locating the Optimal RSS

Connecting the AAU

To connect the AAU:

1. Install the TS-RFU with the antenna attached and direct it in the approximate direction of the BS. Verify that the radio link is commissioned and active.

2. To use the AAU, disconnect the IF cable from the TS-RFU and connect it to the AAU indoor connector.
3. Connect the power cable (part of the AAU kit) to the TS-RFU as shown in Figure 8-17.

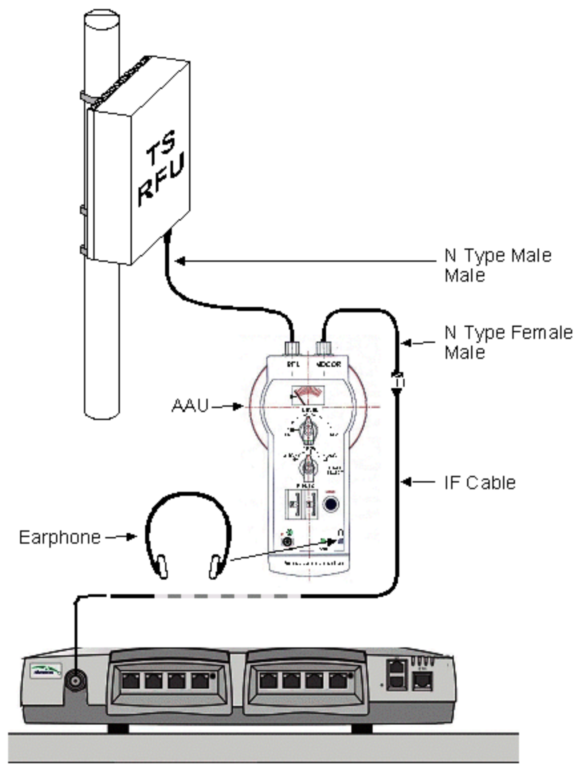


Figure 8-17: Connecting the AAU

Setting the AAU and Detecting the RSS

To set the AAU and detect the RSS:

1. Turn on the AAU.
2. Refer to the Antenna Alignment Unit Manual, Appendix A, pages A11 to A24 for index conversion tables.
3. Press the LOAD button.

   The AAU is now operational and the indicator reflects the measured RSS.

NOTE

The selected channel should be one that is transmitted by the sector of this TS. A conversion table is used so that the selected channel reflects the desired RF frequency.

Locating the Optimal RSS

To locate the optimal RSS:

1. Point the antenna in the approximate direction of the Base Station, so that the RSS is strong enough to be detected by antenna and RFU.
2. Fine-tune the antenna azimuth by aligning it in the direction of the strongest received signal.

NOTE

If the indicator shows a weak signal, rotate the antenna until the signal gets stronger. Continue turning the antenna until optimal reception is achieved.

After passing the optimal point, the signal gets weaker. The installer should now turn the antenna back in the opposite direction until the optimal point is reached again.

If the received signal is too weak or too strong, the needle of the visual indicator will not point to the center and detection of the optimal point will be difficult. Use the Level Selector to adjust the offset level so that the detection of the optimal point is clear and the needle is in the center..

3. After determining the optimal azimuth point, repeat previous steps to determine the elevation point.

NOTE

After aligning the elevation, it is recommended to verify the azimuth alignment again.

9

Chapter 9 - 28 GHz Terminal Station ODU Installation

In This Chapter:

This chapter includes:

Unpacking Guidelines

To unpack the TS system, follow these steps:

1. Carefully cut the sealing tape with a box cutter and open the box.
2. Remove the cardboard packing, any foam packing material, and protective plastic.
3. Compare the packing list with the items you received. If the items on the packing list do not match the items received, notify your Alvarion's representative.

Installation Guidelines

CAUTION

Never install the RFU near power lines.

Before drilling any hole at the site building, make sure there are no electrical wires in the area of the holes.

Assemble the RFU, bands and mounting adapter in a safe location before climbing up to the mounting location. Proceed with extreme caution when climbing, and working at the mounting location.

Before leaving the installation site, check that all hardware on the mount and antenna is secure.

All installations should conform to the local building and electrical codes. If you are not sure, contact a licensed building inspector or electrician in your area to assist you.

Be aware that community conventions, if any, may have additional requirements.

Check your homeowner's insurance policy for any restrictions or exceptions that may apply.

The antenna must be inspected at least once a year to check its condition and to ensure safe operation and maintenance.

Qualified personnel must perform antenna inspection.

Observe the above cautions and the guidelines below to ensure a proper and smooth installation:

- Make sure you have determined the best location for the TS-RFU pole before mounting the pole. Make sure that you can route the IF cable from the location into the building.
- Choose a location that is easily accessible in most weather conditions for proper maintenance.
- Consider seasonal changes. The location may appear clear in the winter, but spring and summer foliage could dramatically attenuate the signal.
- Do not install the TS-RFU where people can block it.
- The TS-RFU and antenna must have a clear line-of-sight to the Base Station. The TS-RFU must be mounted so that the line-of-sight is clear of neighboring buildings, trees, power lines and other obstructions.
- If you are mounting the TS-RFU on the middle of the roof, it is recommended to install the TS-RFU at least 2m above the lowest roofline (for example, the line of the railing can be taken as a reference line). Make sure that there are no walls or blocks in front of the RFU on the roof.
- If you need to mount the RFU on the wall of a building, you must ensure that the RFU-TS will be at least 0.5m away from the wall and no less than 15m above the ground as shown in Figure 9-1.

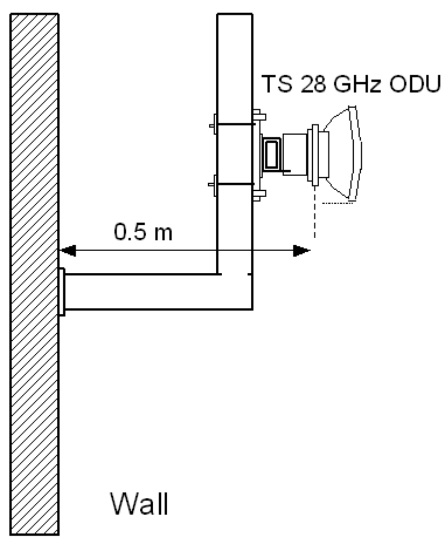


Figure 9-1: Mounting the 28 GHz TS ODU on a Wall

- Do not install the RFU at the top of the pole; always leave at least 40 cm space between the top of the pole and the RFU for better lightning protection (see Figure 9-2).
- It is recommended to install the TS-RFU at the corner of the roof 1m above the railing and no less than 15 m above the ground (see Figure 8-2). If the existing conditions do not match the rules of a specific area, install it according to the previous guideline.

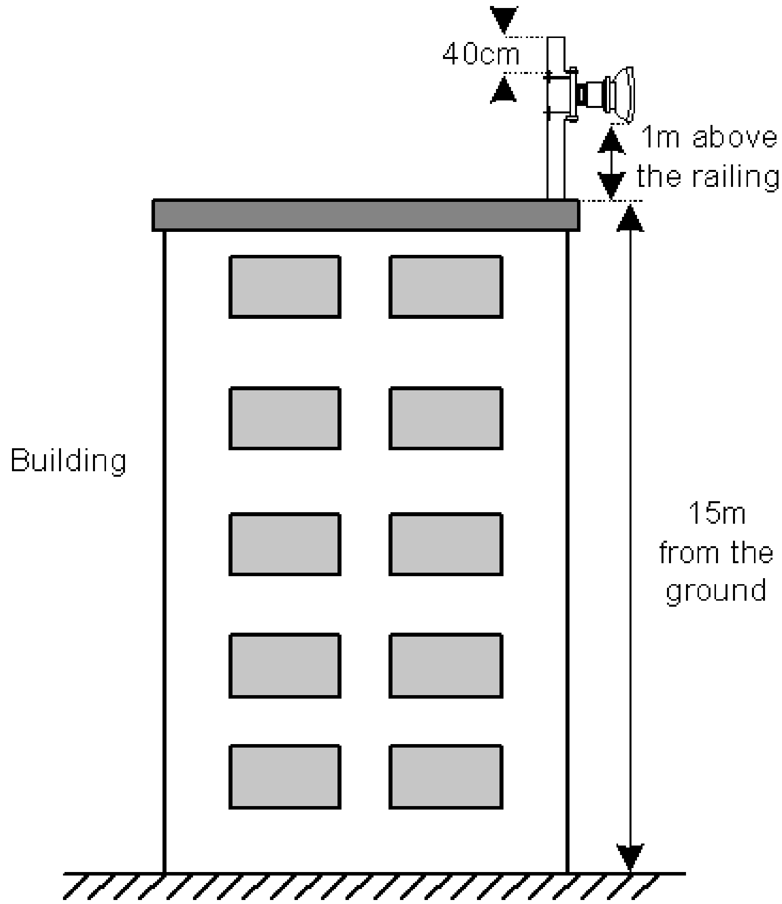


Figure 9-2: Installing the TS 28 GHz ODU on the Roof Corner

Tools Required for Installation

Tools required for TS 28 GHz ODU installation are as follows:

- Cross screwdriver
- 9/16" wrench or adjustable wrench
- 1/2 " wrench or adjustable wrench

Table 9-1 provides the recommended tightening torques for nuts used on stainless steel bolts, galvanized bolts or any bolts without the AST "A325" marking on the head.

Table 9-1: 28 GHz TS ODU Recommended Tightening Torque

Nominal Bolt Size (inches)	Nut Torque		
1/4	50 IN-LBf	0.57 KGf-m	5.65 N-m
5/16	102 IN-LBf	1.175 KGf-m	11.52 N-m
3/8	15 FT-LBf	2.07 KGf-m	20.33 N-m
7/16	24 FT-LBf	3.32 KGf-m	32.54 N-m
1/2	37 FT-LBf	5.11 KGf-m	50.16 N-m

Optional TS-RFU Management Software and Hardware

Optional software can be purchased from Alvarion to electronically adjust a 28 GHz Terminal Station antenna via a laptop computer (for a PDA device, Terminal Station only).

The adjustment method involves first programming the Station RFU for required Radio Gain, then adjusting azimuth for maximum signal reception, and finally adjusting the elevation while maintaining or improving the maximum signal reception.

Equipment required for each method is as follows:

Table 9-2: Terminal Station Antenna Electronic Adjustment

Method	Tools required
Laptop	Laptop computer with Windows OS Optional Software application for Terminal Station: See WALKair 3000 Price List item - **TS-RFU Management SW for Windows** (to install, copy it from the software CD to the laptop) RS-232 Cable with one male and one female D-Type termination: pin-outs as follows: Laptop / TS / Signal: 5 / 5 / GND 2 / 3 / TX 3 / 2 / RX
PDA (Palm)	PDA Optional Software application for Terminal Station: See WALKair 3000 Price List item - **TS-RFU Management SW for Palm OS** (to install, copy it from the TS software CD to the Palm OS) RS-232 Cable with two male D-Type terminations: pin-outs as follows: PDA / TS / Signal: 5 / 5 / GND 2 / 3 / TX 3 / 2 / RX

Laptop pin-outs:

Laptop	TS	Signal
5	5	GND
2	3	TX
3	2	RX

PDA pin-outs:

PDA	TS	Signal
5	5	GND
2	3	TX
3	2	RX

Installing the TS 28 GHz ODU

The TS 28 GHz ODU is supplied with the RFU, antenna and mounting adapter already assembled as a unit as shown in Figure 9-3.

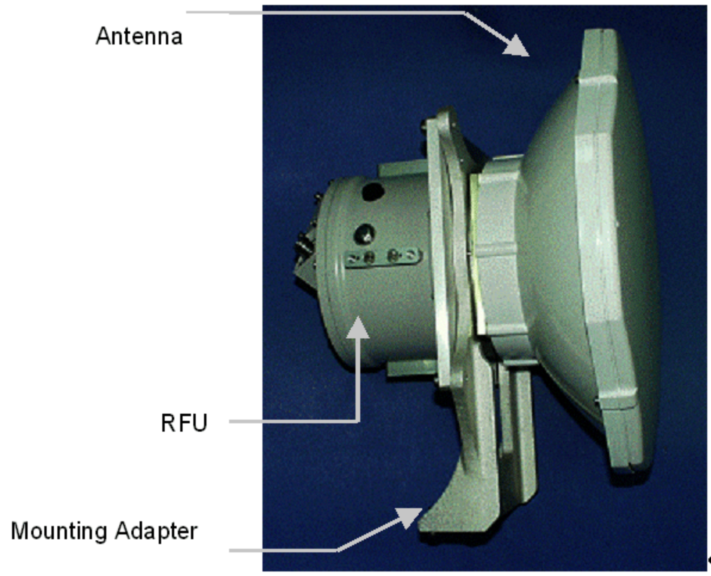


Figure 9-3: TS-ODU as Supplied from Manufacturer

Installing the Terminal Station 28 GHz ODU includes:

- Installing the azimuth adjustment plate on page 9-8
- Installing the pole mounting plate on page 9-9
- Attaching the TS 28 GHz ODU to the Elevation Adjustment Plate on page 9-10
- Installing the ODU/elevation assembly on the pole mount assembly on page 9-11
- Adjusting the TS 28 GHz ODU Antenna on page 9-12
- Connecting the Cables on page 9-25

Installing the Azimuth Adjustment Plate

To install the azimuth adjustment plate on the pole/mast:

1. Before installing, decide on which side of the pole to install the antenna. You will install the azimuth adjustment plate on the opposite side.
2. Referring to Figure 9-4, fix the azimuth adjustment plate to the pole. Use the U-bolt and flat washer, split lock washer, and 3/8" - 16 bronze nuts.
3. Fully tighten the nuts so that the azimuth adjustment plate is secured. The recommended nut torque is 15 ft-lb.

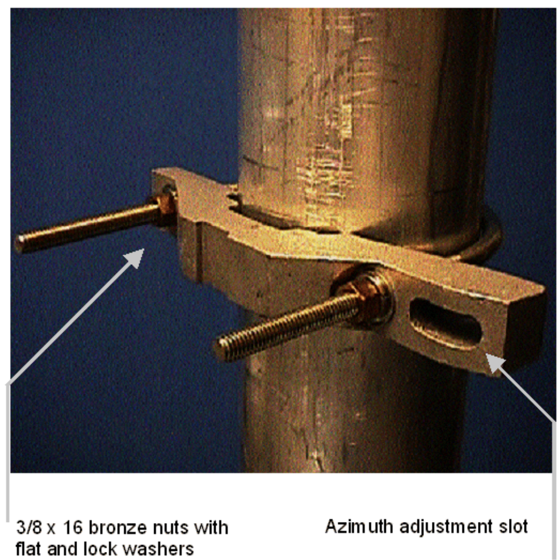


Figure 9-4: Azimuth Adjustment Plate

Installing the Pole Mounting Plate

To install the pole mounting plate:

1. Referring to Figure 9-5, position the pole mount plate assembly against the pole directly opposite the azimuth adjustment plate.
2. The fine adjustment rod is attached to the pole mounting plate when shipped from the factory. Remove the 3/8 hex nut, flat and split lock washer.
3. Slip the rod into the azimuth adjustment plate slot (see also Figure 9-4).

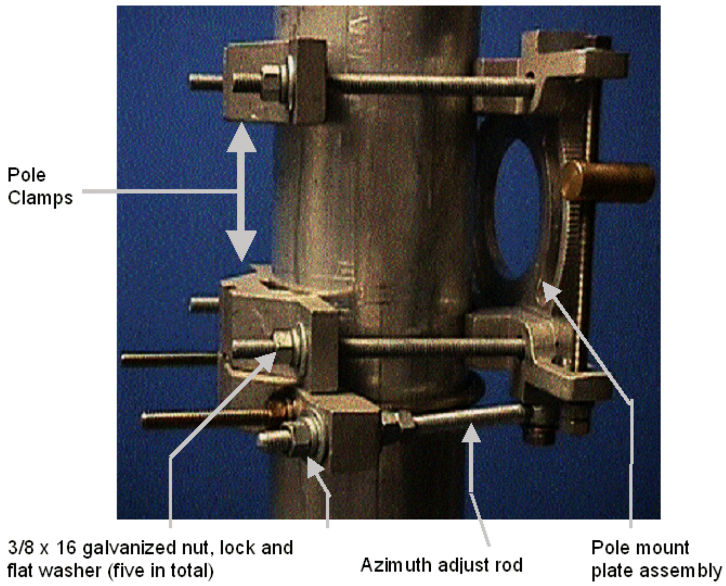


Figure 9-5: Pole Mounting Plate

4. Attach the pole mounting assembly to the pole using the two pole clamps and the four 3/8 –16 x 6.0" galvanized bolts, galvanized split lock washers, galvanized flat washers and 3/8-16 galvanized hex nuts.

CAUTION

Do not completely tighten the nuts yet.

5. With the rod in position through the slot of the azimuth adjust bracket, add one galvanized flat washer, one galvanized split lock washer and 3/8-16 galvanized hex nut.

Attaching the 28 GHz TS ODU to the Elevation Adjustment Plate

To attach the 28 GHz TS ODU to the elevation adjustment plate:

1. Referring to Figure 9-6, attach the elevation adjustment plate (on the TS 28 GHz ODU assembly) to the antenna mount as shown in figures x and y. Use five ¼-20 pan head screws and split lock washers.
2. Fully tighten the screws to the recommended torque of 50 in-lb.

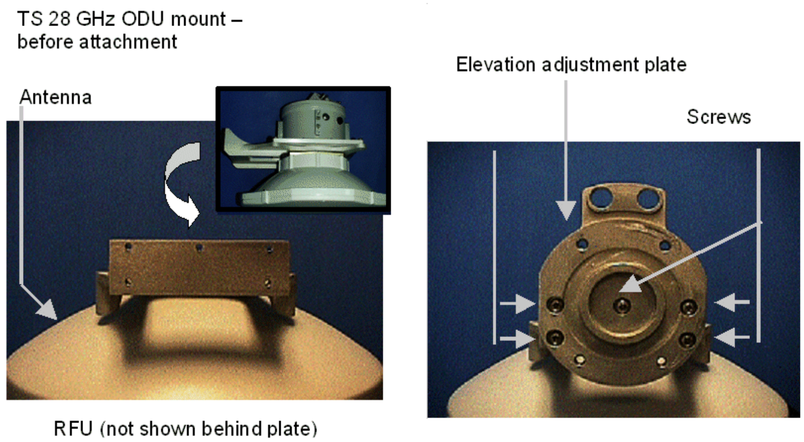


Figure 9-6: Elevation Adjustment Plate Attachment

Installing the ODU/Elevation Assembly on the Pole Mount Assembly

To install the ODU/elevation assembly on the pole mount assembly:

1. Align the large diameter hub on the elevation adjustment plate to the pole mount plate (see Figure 9-7).
2. Insert the brass rod into the elevation adjustment hole. For maximum downlook, insert the brass rod into the lower hole. For uplook angle, insert the rod into the top hole (see Figure 9-8).

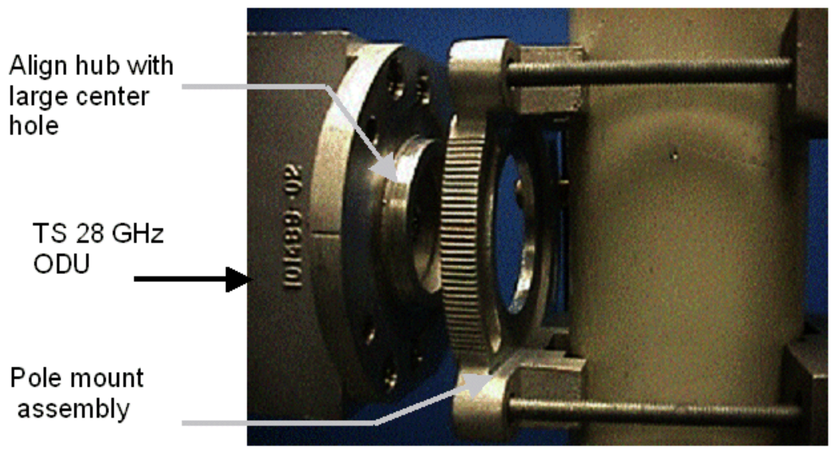


Figure 9-7: Aligning the Hub

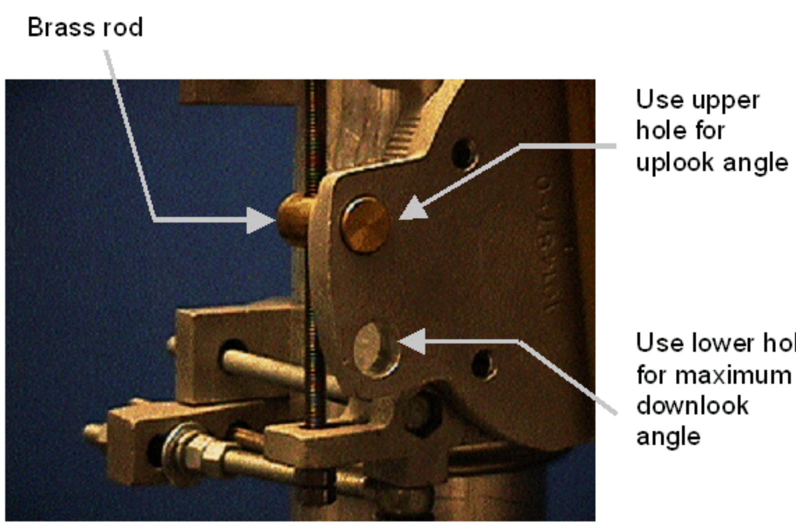


Figure 9-8: Inserting the Brass Rod

3. Referring Figure 9-9, attach the elevation assembly to the pole mount assembly using four flat washers, split lock washers, nylon washers and hex bolts.
4. Tighten the bolts until the hardware is snug with the pole, but do not fully tighten at this point.

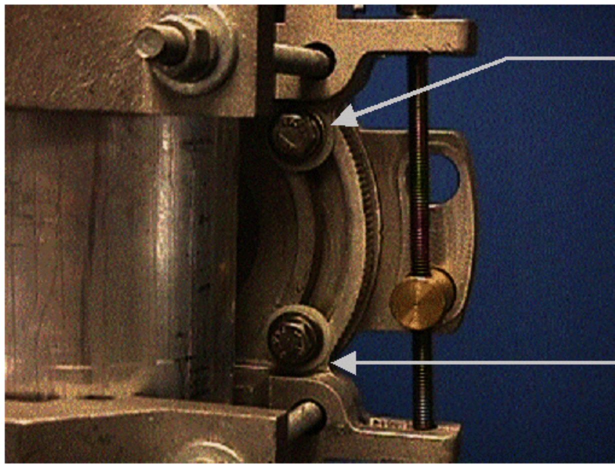


Figure 9-9: Attaching Elevation Assembly to Pole Mount Assembly

Adjusting the TS 28 GHz ODU Antenna

Adjusting the TS 28 GHz ODU antenna includes:

- Fine Azimuth Adjustment, on this page
- Fine Elevation Adjustment, on page 9-14
- Vertical/Horizontal Adjustment, on page 9-16
- Adjustment Using Optional TS-RFU Management Software, on page 9-16.

Fine Azimuth Adjustment

Fine Azimuth adjustment enables ± 10° accuracy.

If you are using **Optional TS-RFU Management Software**:

- For adjustment with a laptop computer: perform this procedure in conjunction with Adjusting with a Laptop, on page 9-16. on page 9-21.
- -OR-
- For adjustment with a PDA device: perform this procedure in conjunction with Adjusting with a PDA, on page 9-22.

Clockwise Fine Adjustment

To adjust the azimuth clockwise:

1. Referring to Figure 9-10, loosen the four azimuth lock bolts on the pole mount clamps.
2. Using a 9/16 or an adjustable wrench, loosen the two 3/8-16 inner galvanized hex nuts on the azimuth adjustment rod.

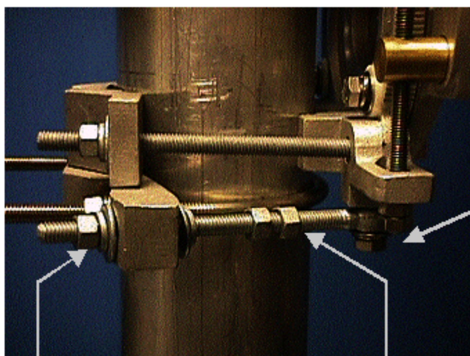


Figure 9-10: Clockwise Azimuth Adjustment

3. To rotate the antenna clockwise, tighten the outer 3/8-16 hex nut on the azimuth adjustment rod until the antenna is in the required position.
4. Fully tighten the two inside nuts to the recommended torque of 15 ft-lb. Tighten the four azimuth lock bolts to the same torque.

CAUTION

Tighten the pole clamps evenly to avoid a gap between the clamp and pole.

Counter clockwise Fine Adjustment

To adjust the azimuth counter clockwise:

1. Referring to 9-11, loosen the four azimuth lock bolts.
2. Using a 9/16 or an adjustable wrench, loosen the outer 3/8-16 outer galvanized hex nut on the azimuth adjustment rod. Leave at least three threads exposed.

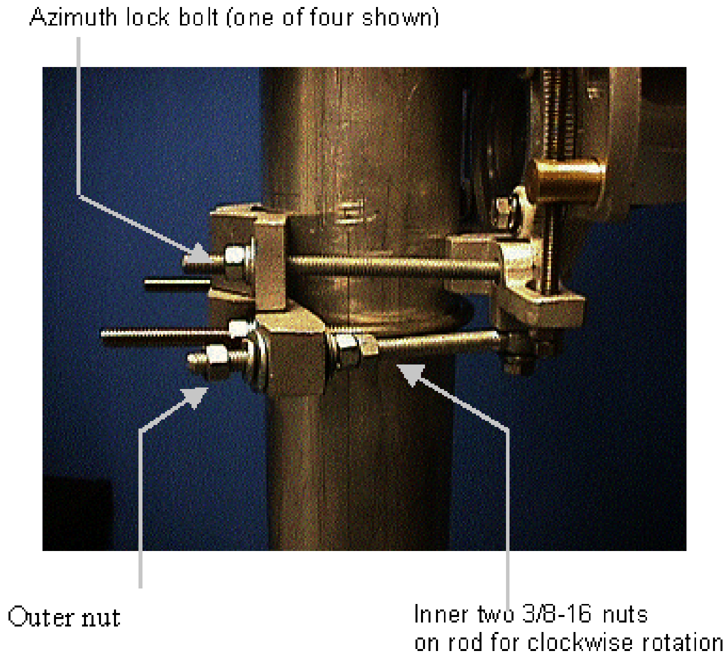


Figure 9-11: Counter Clockwise Azimuth Adjustment

3. To rotate the antenna counter clockwise, tighten the two inner 3/8-16 hex nuts on the azimuth adjustment rod until the antenna is in the required position.
4. Fully tighten the outside 3/8-16 nut to the recommended torque of 15 ft-lb. Tighten the four azimuth lock bolts on the pole mount clamps to the same torque.

CAUTION

Tighten the pole clamps evenly to avoid a gap between the clamp and pole.

Fine Elevation Adjustment

Fine elevation adjustment enables ± 25°.

If you are using **Optional TS-RFU Management Software**:

- For adjustment with a laptop computer: perform this procedure in conjunction with Adjusting with a Laptop, on page 9-16.
on page 9-21.
- -OR-
- For adjustment with a PDA device: perform this procedure in conjunction with Adjusting with a PDA, on page 9-22.

Uplook Adjustment

To adjust uplook:

1. Referring to Figure 9-12, using a 1/2" or adjustable wrench, rotate the elevation rod adjust nut counter clockwise to the required position.
2. Using a 9/16" or adjustable wrench, tighten the four 3/8-16 bolts on the elevation adjustment plate to the recommended torque specification of 15 ft-lb.

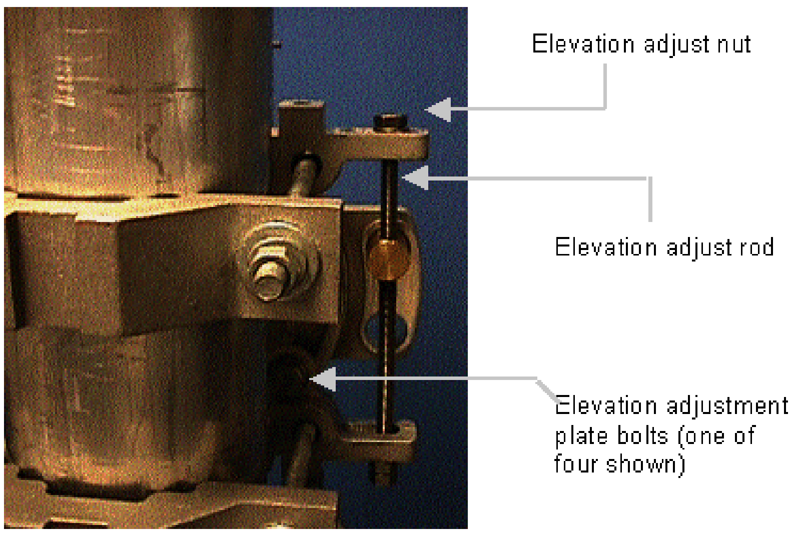


Figure 9-12: Uplook Adjustment

Downlook Adjustment

To adjust downlook:

1. Referring to Figure 9-12, using a 1/2" or adjustable wrench, rotate the elevation rod adjust nut clockwise to the required position.
2. Using a 9/16" or adjustable wrench, tighten the four 3/8-16 bolts on the elevation adjustment plate to the recommended torque specification of 15 ft-lb.

Vertical/Horizontal Adjustment

The default polarization for the antenna is vertical polarization.

To change the antenna polarization:

1. Remove the RFU from the antenna.
2. Rotate the antenna by 90°.
3. Remount the RFU onto the antenna.

Adjustment Using Optional TS-RFU Management Software

The TS-RFU Management Software enables you to set Radio Gain for RX and TX, and detect maximum signal reception.

Software is available for both laptops and PDA (Palm Pilot). The following techniques are described below:

- Adjusting with a Laptop, on this page
- Adjusting with a PDA, on page 9-22

Adjusting with a Laptop

See also Optional TS-RFU Management Software and Hardware, on page 9-6.

The procedure is performed in five steps as follows:

Step 1 – Connecting the Laptop to the Terminal Station, on this page

Step 2 – Setting the Radio Gain, on page 9-17

Step 3 – Setting Azimuth for Maximal Signal Reception, page 9-21

Step 4 – Setting the Elevation for Maximal Signal Reception, page 9-21

Step 5 – Completing the Procedure, on page 9-21

Step 1 – Connecting the Laptop to the Terminal Station

To connect the laptop to the Terminal Station:

1. Referring to Figure 9-13, locate the software connector weatherproof cover on the Terminal Station. Release the four fixing screws and put them along with the cover in a safe place.

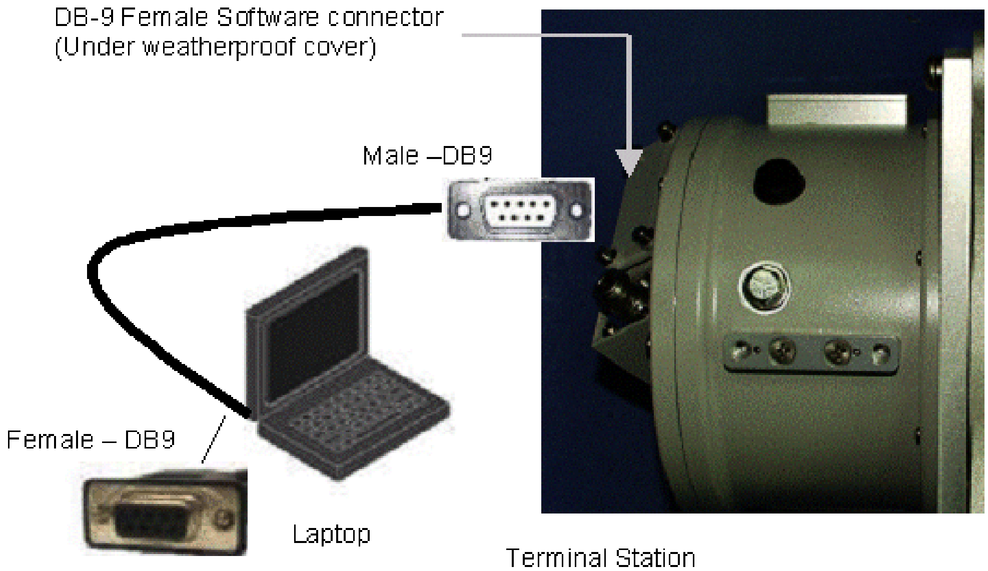


Figure 9-13: TS Software Connection

2. Attach a D-Type cable from the laptop to the Terminal Station software connector.
   See Optional TS-RFU Management Software and Hardware, on page 9-6.

Step 2 – Setting the Radio Gain

To set the Radio Gain:

1. Open the TS-RFU Management Software on the laptop by double-clicking the icon.

   The TS-RFU Management Software window is displayed below.

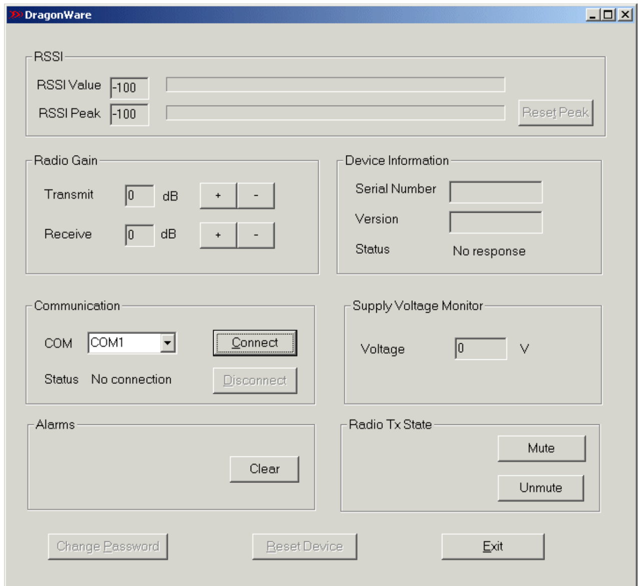


Figure 9-14: TS-RFU Management Software Window

2. Click the  button to connect to the Terminal Station.

   When the password window appears (as displayed below), if you are using the application for the first time, type the default password **123**, and then click **OK**.

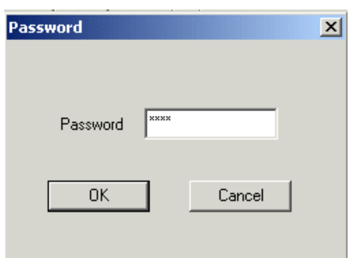


Figure 9-15: TS-RFU Management Software Password Window

NOTE

To request an alternative password, please contact Alvarion Technical Support.

The Terminal Station Serial Number and Version Number will appear in the *Device Information* section, as shown below.

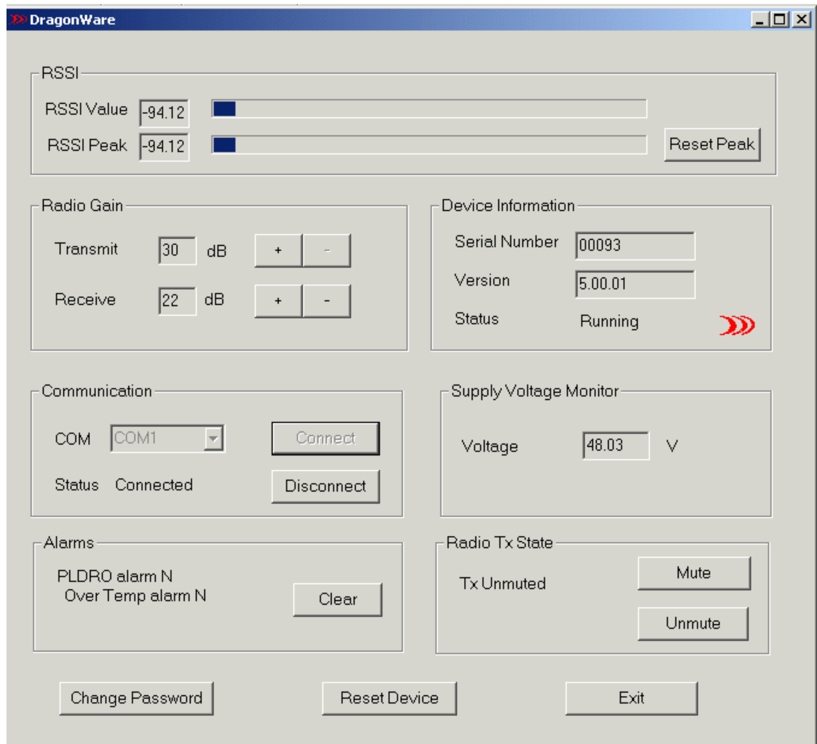


Figure 9-16: TS-RFU Management S/W Window, after Login

3. Check the Terminal Station Supply Voltage in *the Supply Voltage Monitor* area of the window.

4. Referring to Table 9-3, select the **Transmit (Tx)** and **Receive (Rx) Gain values (in DBm),** corresponding to the Cable Gain (attenuation) for your system in dBm

5. In the *Radio Gain* area of the window, using the adjacent 

buttons, enter the **Transmit (Tx)** and **Receive (Rx) Gain values** (from the previous step).

Table 9-3: TS Radio Gain, and Cable Gain (Attenuation)			
Tx		**Rx**	
Tx Gain	**Cable Gain**	**Rx Gain**	**Cable Gain**
40	-12	40	-20
39	-11	39	-19
38	-10	38	-18
37	-9	37	-17
36	-8	36	-16
35	-7	35	-15
34	-6	34	-14
33	-5	33	-13
32	-4	32	-12
31	-3	31	-11
30	-2	30	-10
		29	-9
		28	-8
		27	-7
		26	-6
		25	-5
		24	-4
		23	-3
		22	-2

Step 3 – Setting Azimuth for Maximal Signal Reception

To set Azimuth for maximum signal reception:

Read and perform this procedure **in conjunction with** Fine Azimuth Adjustment, on page 9-12.

1. The **RSSI** area of the TS-RFU Management Software window in Figure 9-16 includes fields and bars for numeric and graphic representations of signal strength.
2. Adjust the antenna azimuth hex nuts until the maximum signal strength is achieved. You can use either Peak or Value. They will be almost identical.
3. Tighten the four azimuth lock bolts.
4. Check the signal strength once again. Repeat adjustment if necessary.
5. Proceed to Step 4 below.

Step 4 - Setting the Elevation for Maximal Signal Reception

To set the Elevation for maximum signal reception:

Read and perform this procedure **in conjunction with** Fine Elevation Adjustment, on page 9-14.

1. The **RSSI** area of the TS-RFU Management Software window in Figure 9-16 includes fields and bars for numeric and graphic representations of signal strength.
2. Adjust the antenna elevation rod adjust nut until the maximum signal strength is achieved. You can use either Peak or Value. They will be almost identical.
3. Tighten the four lock bolts on the elevation adjustment plate.
4. Check the signal strength once again. Repeat adjustment if necessary.

Step 5 – Completing the Procedure

To complete the procedure:

- Click the Disconnect button to exit the software, and disconnect the serial cable from the Terminal Station.

Adjusting with a PDA

See also Optional TS-RFU Management Software and Hardware, on page 9-6.

The procedure is performed in five steps as follows:

Step 1 – Connecting the PDA to the Terminal Station, on this page

Step 2 – Setting the Radio Gain, on page 9-23

Step 3 – Setting Azimuth for Maximal Signal Reception, on page 9-24

Step 4 – Setting the Elevation for Maximal Signal Reception, page 9-24

Step 5 – Completing the Procedure, on page 9-25

Step 1 – Connecting the PDA to the Terminal Station

To connect the PDA to the Terminal Station:

1. Referring to Figure 9-13, locate the software connector weatherproof cover on the Terminal Station. Release the four fixing screws and put them along with the cover in a safe place.

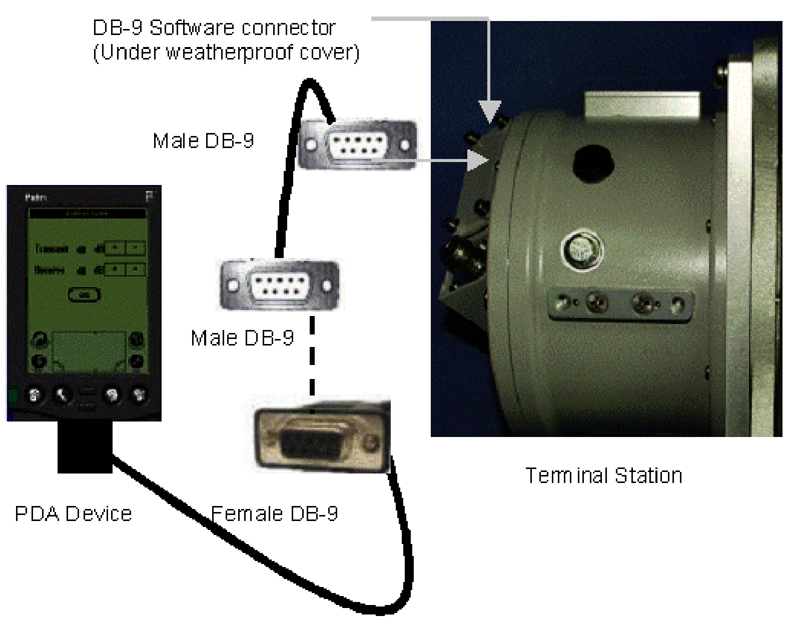


Figure 9-17: TS Software Connection

2. Attach a D-Type cable from the PDA to the Terminal Station software connector.
   See Optional TS-RFU Management Software and Hardware, on page 9-6.

Step 2 – Setting the Radio Gain

To set the Radio Gain:

1. On the PDA, open the TS-RFU Management Software application.

   The TS-RFU Management Software screen is displayed as shown below.

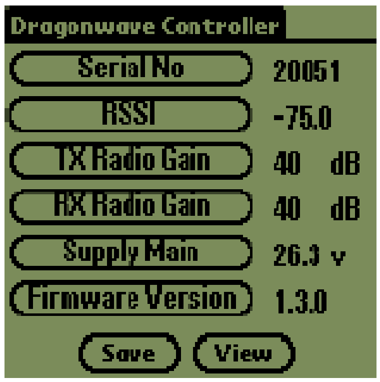


Figure 9-18: TS-RFU Management Software Screen

2. Referring to Table 9-3, select the **Transmit (Tx)** and **Receive (Rx) Gain values (in DBm),** corresponding to the Cable Gain (attenuation) for your system in dBm

3. In the *Radio Gain* area of the window, using the adjacent  buttons, enter the **Transmit (Tx)** and **Receive (Rx) Gain values** (from the previous step).

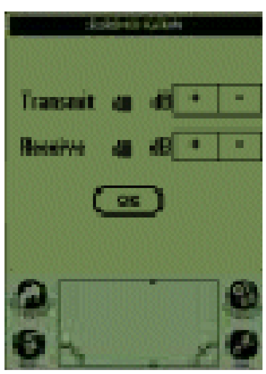


Figure 9-19: Radio Gain Screen

4. Click on **OK** to confirm the changes.

Step 3 – Setting Azimuth for Maximal Signal Reception

To set Azimuth for maximum signal reception:

Read and perform this procedure **in conjunction with** Fine Azimuth Adjustment, on page 9-12.

1. In the TS-RFU Management Software screen, click **RSSI**.

   The RSSI Level screen is displayed.

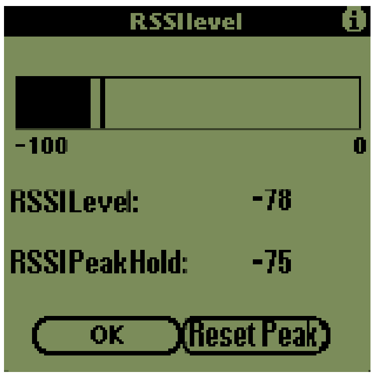


Figure 9-20: RSSI Level Screen

   The **RSSI** screen includes fields and bars for numeric and graphic representations of signal strength.

2. Adjust the antenna azimuth hex nuts until the maximum signal strength is achieved. You can use either Peak or Value. They will be almost identical.
3. Tighten the four azimuth lock bolts.
4. Check the signal strength once again. Repeat adjustment if necessary.
5. Proceed to Step 4 below.

Step 4 - Setting the Elevation for Maximal Signal Reception

To set the Elevation for maximum signal reception:

Read and perform this procedure **in conjunction with** Fine Elevation Adjustment, on page 9-14.

1. The **RSSI** area of the TS-RFU Management Software window in Figure 9-14 includes fields and bars for numeric and graphic representations of signal strength.
2. Adjust the antenna elevation rod adjust nut until the maximum signal strength is achieved. You can use either Peak or Value. They will be almost identical.
3. Tighten the four lock bolts on the elevation adjustment plate.
4. Check the signal strength once again. Repeat adjustment if necessary.

Step 5 – Completing the Procedure

To complete the procedure:

- Exit the PDA TS-Management software, and disconnect the serial cable from the Terminal Station.

Connecting the Cables

Figure 9-22 shows the TS 28 GHz ODU connections. Table 9-4 describes the connections.

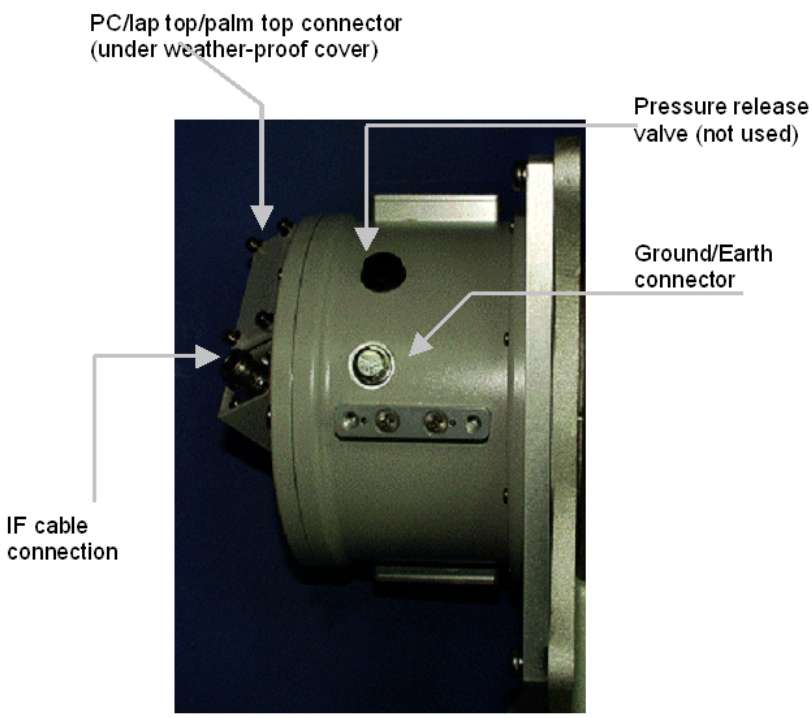


Figure 9-21: Connecting the TS 28 GHz ODU

Table 9-4: TS 28 GHz Cables and Connections

Cable	Connector	From	To
IF/DC	COAX LMR 50 Ω/ N-Type	TS ODU	BS IDU
Ground/earth	M6 screw diameter	TS ODU	Ground/earth
Digital Control	D-Type 9 pin	TS ODU	PC/lap top/palm

Connecting the TS 28 GHz ODU Cables includes:

- Connecting the ground/earth cable
- Connecting the IF cable

Connecting the Ground/Earth Cable

To connect the ground/earth cable (See Figure 9-22):

- Connect the ground/earth cable to the TS ODU.

Connecting the IF cable

To connect the IF cable:

- Referring to Figure 9-22, connect a single coaxial cable is between the ODU and the TS IDU IF connector. For a cable length greater than 150m, use a higher quality cable than the LMR400, since the total cable attenuation must not exceed 20dB regardless of its length.
- At the RFU end of the cable, leave a Service Loop.
  Refer to Figure 9-23. When routing the coaxial cable, leave a **service loop** at the RFU end to provide a sufficient length of cable to allow replacement of a faulty connector, when necessary. Secure the coaxial cable so that there is no mechanical stress at the RFU connection. Follow the superstructure with the coaxial cable to its base, and then to the building. If the coaxial cable requires suspension from the base to the building, use a stranded wire to support the coaxial cable weight (This support will prevent a migration of the cable's inner conductor to the shield).
- Sealing the ODU Connector – See Sealing the ODU Connector.

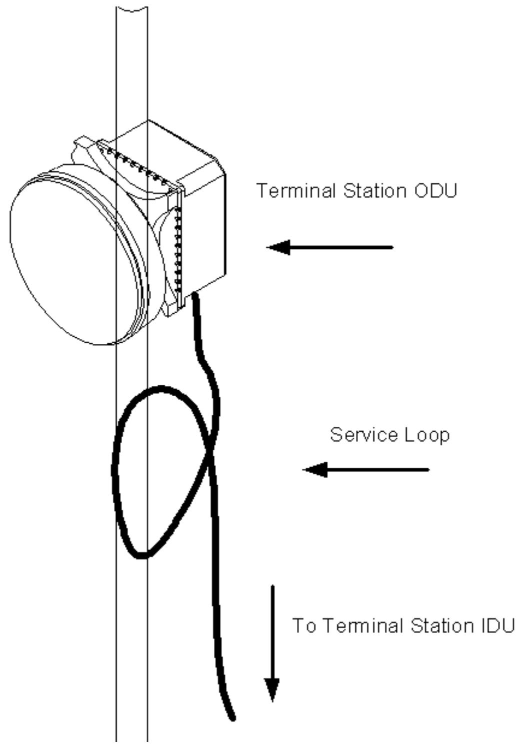


Figure 9-22: TS 28 GHz-ODU Service Loop

CAUTION

The IF cable connector must be a certified outdoor connector.

The outdoor connectors should be tightened using sleeves.

At the RFU end of the cable, leave a Service Loop (see above).

Inspection and Maintenance

Before leaving the installation, check that all hardware on the mount and antenna are fully secured according to the recommended torques.

An antenna inspection must be performed at least once a year to ascertain its condition and to ensure safe operation and maintenance.

Qualified personnel must carry out the inspection.

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10

Chapter 10 - Terminal Station IDU Installation

In This Chapter:

This chapter includes:

Terminal Station IDU Mounting

The Terminal Station Indoor Unit (TS- IDU) component of the WALKair 3000 system is typically installed at the customer's site. Power is supplied to the TS from an external 110/220VAC source.

The Terminal Station IDU can be mounted with either of the following options:

- Wall mounting
- Desktop mounting
- Rack mounting

Mounting a Terminal Station IDU on a Wall

To mount the Terminal Station on a wall:

1. Referring to Figure 10-1, turn the Terminal Station IDU upside down and locate the two wall mounting holes.
2. Measure the distance between the holes. Prepare the wall for mounting. It is recommended to use rawlplugs and screws.

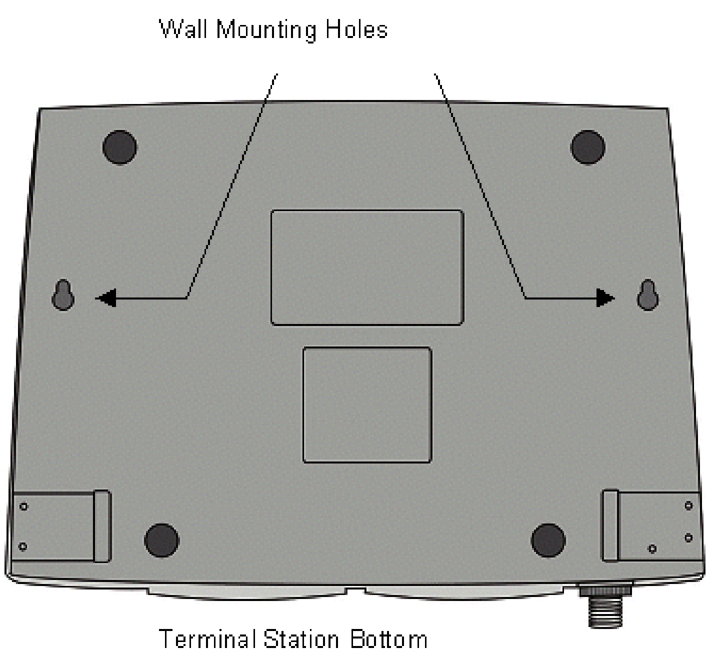

Figure 10-1: Terminal Station IDU Wall Mounting

Mounting a Terminal Station IDU on a Desktop

The TS-BU comes with four miniature support legs for the desktop option. Attach the support legs and place on a clean, flat surface as shown in Figure 10-2.

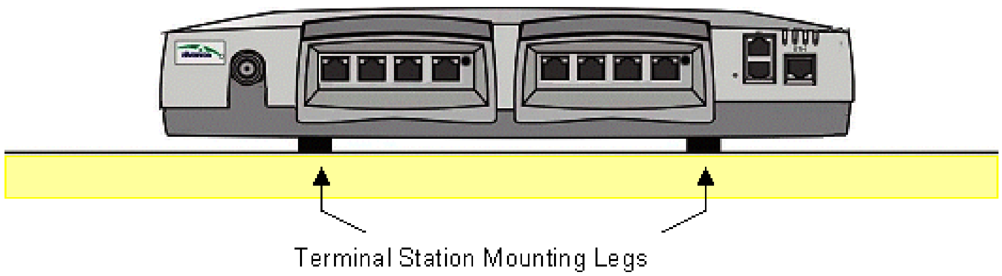

Figure 10-2: Desktop Mount

Mounting a Terminal Station IDU on a Rack (19" or ETSI Racks)

The Terminal Station (TS-IDU) equipment can be installed in either an ETSI or 19" rack using horizontal mounting. The TS-IDU is supplied with rack mounting brackets suitable for installation in both rack types.

Before beginning the installation, verify that the rack is grounded in accordance with the local standards.

To install the Terminal Station IDU on a rack

1. Turn the Terminal Station upside down and slide the side brackets into place.
2. Insert the screws provided and secure them.
3. Turn the unit the right way up.
4. Fix the Terminal Station to the rack. Use the screws provided, two for each side bracket.

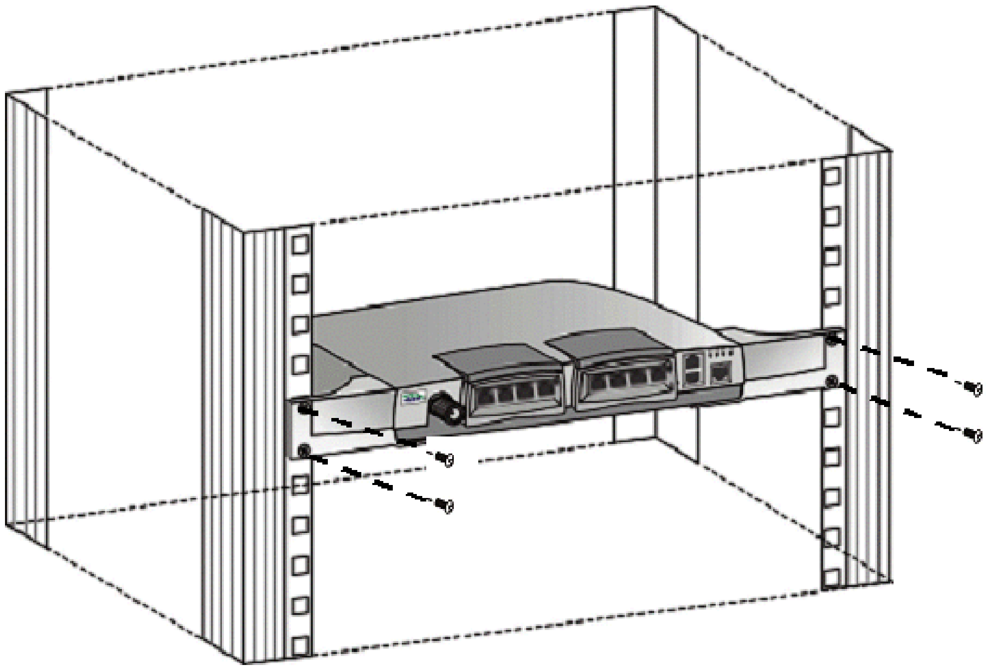

Figure 10-3: Fixing the Terminal Station to the Rack

The TS-IDU ground screw is connected to the earth ground (the ground screw is located on the rear panel of the TS-IDU and the ground pin diameter is MC8).

Terminal Station IDU Cabling

The Terminal Station TS-IDU interfaces between the CPE and the WALKair 3000 TS-ODU.

Figure 10-4 shows the Terminal Station IDU front panel and Figure 10-5 shows the rear panel.

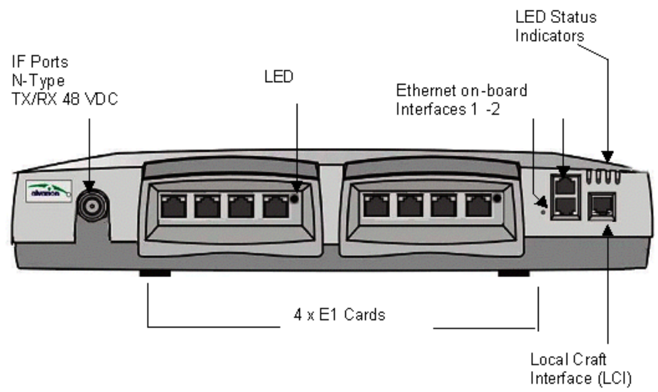

Figure 10-4: Terminal Station IDU Front Panel

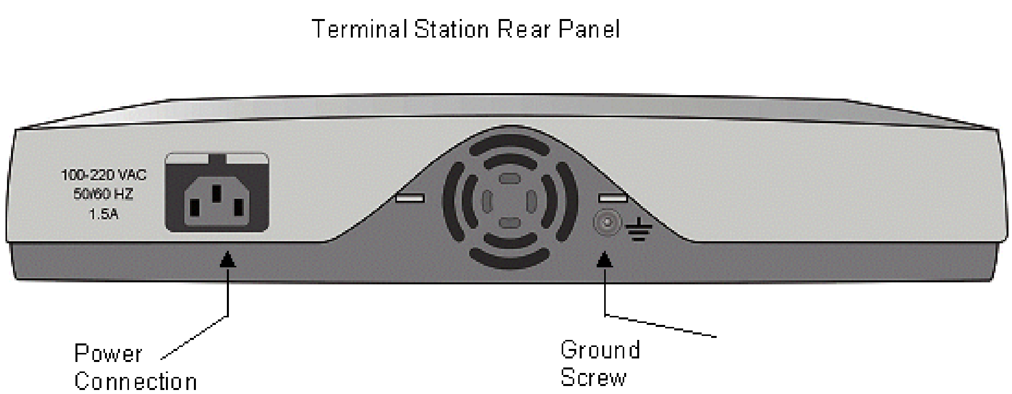

Figure 10-5: Terminal Station IDU Rear Panel

Table 10-1 lists the Terminal Station connectors.

Table 10-1: Terminal Station Interface Connectors		
Interface	**Type/Rate**	**Description**
Dual 4 x E1	RJ45	Each port provides the interface to a 2 Mbps channel.
2 x Ethernet	RJ45, 802.3 10/100 Base T	Used also for connection to WALKnet Network Management System.
LCI	RJ45	Provides an interface to a local craft terminal for management purposes.
IF Port	N-Type TX/RX 48 VDC	Provides the interface to the RFU.
Power (located on rear panel)	3-Pin IEC Socket	Provides operating power to the TS-BU using 110/220V AC. Or Optional –48V.
Ground		Located on rear panel

Connecting the Terminal Station IDU to Ground

To connect the Terminal Station IDU to Ground (see Figure 10-5):

Connect an earth cable to the grounding point on the rear panel of the Terminal Station IDU.

Connecting the Terminal Station IDU to Power

To connect the Terminal Station IDU to Power (see Figure 10-5):

Connect a 220 VAC power cable to the rear panel of the Terminal Station IDU.

NOTE

In case of a 48V Terminal Station IDU, the same power cable as for the BS-SA is used.

Connecting the Terminal Station IDU to the Terminal Station ODU

To connect the Terminal Station IDU to the ODU (Figure 10-4):

Connect the cable from the ODU to the N-Type jack IF Port on the front panel of the Terminal Station IDU.

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A

Appendix A - Site Survey Report

In This Appendix:

- Site Survey Report, to be filled-in by the customer before installation.

Site Survey Report

General Site Data

Site Name	______________________
Site Address	______________________
Site Type	☐ BS ☐ TS
Telephone	______________________
Contact Person	______________________
UTM Co-Ordinates	______________________
Altitude Above Sea Level	__________ m
Distance From Sea or River	__________ km

TS distance from BS and azimuth regarding the BS (relevant for BS only):

TS Number	TS Name	Distance from BS (Km)	Azimuth (°) to the BS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Azimuth to BS (for TS): ____________

Line of Sight Data

The line of sight is an unobstructed view from transmitter to receiver.

For optimum system performance, line of site testing must include the mapping of the following obstacles: buildings, sea, rivers, hills, etc.

Obstacle Photo Number	Description	Possibilities for Interference
1.		
2.		
3.		
4.		

Radio Survey

Existing Antennas

	Type	Mast	Height	Frequency	Azimuth	Direction
1.						
2.						
3.						
4.						

Comments:

Spectrum Images

Spectrum Image	RBW	Angle Relative to North	Antenna Beam Width
Image 1			
Image 2			
Image 3			
Image 4			
Image 5			
Image 6			
Image 7			
Image 8			
Image 9			
Image 10			

Existing Rack Survey

If there is no existing rack, ignore this section and proceed to the next section of this appendix.

If there is an existing rack, fill in the following forms:

Rack Climate

Air conditioning	☐ Available	☐ Not available
Fan	☐ Available	☐ Not available

Comments: ____________________

____

____

____

Rack Readiness for Installation

Power Supply

☐ DC –48V	☐ AC 220V Customer	☐ Other
AC Distributor (distance from rack)	________ m	________ m
DC Distributor (distance from rack	________ m	________ m
RBC – Earth Bar (distance from rack)	________ m	________ m

Power Distribution Panels

AC Fuse Panel min. 2A blow (customer supplied)	☐ Available	☐ Not available
DC Fuse Panel min. 5A blow (customer supplied)	☐ Available	☐ Not available
DC Fuse Space for Installation	☐ Available	☐ Not available

Comments: ____________________

Rack Parameters

Raised Floor	☐ Available	☐ Not available
Grounding Point	☐ Available	☐ Not available
Rack Type	☐ 19"	☐ ETSI
Rack Depth	☐ 600 mm	☐ Not available
Rack Ventilation	☐ Available	☐ Not available
BS Installation	☐ Horizontal	☐ Vertical
Screw Type	____________________	
Ohm Type	____________________	
Front / Back Door	☐ Available	☐ Not available
Free Space for Installation	☐ Available	☐ Not available

Comments: ____________________

IF Cable Survey

Cable Duct	☐ Available	☐ *Not available	Length	________
High Power RF cables near IF cable duct	☐ Yes	☐ No		
High voltage power cables near IF cable duct	☐ Yes	☐ No		

Comments: *If checked, cable duct must be prepared.

Customer Interface

Network Interface

Type and Manufacture ______________________

Service ______________________

Data Traffic Interfaces

1 Type ______________________

Service ______________________

2 Type ______________________

Service ______________________

3 Type ______________________

Service ______________________

4 Type ______________________

Service ______________________

5 Type ______________________

Service ______________________

6 Type ______________________

Service ______________________

BS Source Clock

☐ NIU ☐ Priority ☐ Slot

☐ Internal

☐ External Clock

Control Connections

____

Pole and Tower

Tower/Mast

☐ Available ☐ Not Available Comp Date: ____________

Mast Height (m) ____________

Mast Diameter
(min. 5 cm, max. 10 cm) ____________

Comments: ____________

Tower Data

Lightning Protection	☐ Available	☐ Not Available
Obstruction Light	☐ Available	☐ Not Available
Climbing Ladder	☐ Available	☐ Not Available
Protective Earthing (Grounding)	☐ Available	☐ Not Available
Extension	☐ Possible	☐ Not Possible
Condition	☐ Very Good	☐ Good
	☐ Poor	☐ Very Poor

General Comments

This page left intentionally blank.

B

Appendix B - Pin-Outs

In This Appendix:

- This appendix provides the pin-out assignment for the Base Station and Terminal Station connectors of the WALKair 3000 system.

BS-SA Pin-Out

Table B-1: Table BS SA ETH Connector Pin-out (RJ-45)

Pin	Signal Name
1	RD+
2	RD-
3	TD+
6	TD-
4, 7, 8	-

Table B-2: BS-SA E1 (1 to 8) Connector Pin-outs (RJ-45)

Pin	Signal Name
1, 2	Tx
4, 5	Rx
3, 6-8	-

Table B-3: BS-SA LCI Connector Pin-outs

RJ-45 Pins (BS-BU)	Signal Name	D type 25 Pins (CPU)	D type 9 Pins (CPU)
1	-		
2	RXD	2	3
3	TXD	3	2
4	-		
5	GND	7	5
6	-		
7	-		
8	-		

IF Mux Pin-out

Table B-4: WALkair 1000 Redundancy BS Connector R Pin-out		
Pin	**Signal Name**	**Direction**
1	IFMUX_EXIST	Out
2	RFU_CURRENT	Out
3	MUX_RFU_ON	In
4	GROUND	
5	BU_ACT	In
6	IFMUX_LED_0	In
7	IFMUX_RFU	Out
8	MUX_RFU_SELECT	In

Table B-5: WALkair 1000 Interface BS Connector I Pin-out		
Pin	**Signal Name**	**Direction**
1	IFMUX_TYPE_0	Out
2	IFMUX_TYPE_1	Out
3	IFMUX_TYPE_2	Out
4	GROUND	
5	BU_NUM_0	Out
6	BU_NUM_1	Out
7	BU_NUM_2	Out
8	BU_NUM_3	Out

Table B-6: WALkair 3000 Interface BS Connector Comm Pin-out		
Pin	**Signal Name**	**Direction**
1		
2	Txd	Serial com. out
3	Rxd	Serial com. in
4		
5	GROUND	
6		
7		
8		

TS-BU Pin-Out

Table B-7: TS IDU ETH (1 to 4) Connector Pin-out (RJ-45, MIDX)	
Pin	**Signal Name**
1	RD+
2	RD-
3	TD+
6	TD-
4, 7, 8	-

Table B-8: TS IDU E1 Connector Pin-out (RJ-45)	
Pin	**Signal Name**
1, 2	Tx
4, 5	Rx
3, 6-8	-

Table B-9: TS IDU LCI Connector Pin-out (RJ-45)			
RJ-45 Pins (TS IDU)	**Signal Name**	**D type 25 Pins (CPU)**	**D type 9 Pins (CPU)**
1	-		
2	RXD	2	3
3	TXD	3	2
4	-		
5	GND	7	5
6	-		
7	-		
8	-		

E1-Switch Pin-Out

Table B-10: E1 Switch Network I/F 1 Connector Pin-out (D-sub HD 44-pin)					
Pin	**Signal Name**	**Pin**	**Signal Name**	**Pin**	**Signal Name**
1	E1-01-TXP	16	E1-01-TXN	31	E1-01-RXN
2	E1-02-TXN	17	E1-01-RXP	32	CGND
3	E1-02-TXP	18	E1-02-RXN	33	E1-02-RXP
4	E1-03-TXN	19	CGND	34	E1-03-RXN
5	E1-03-TXP	20	E1-03-RXP	35	CGND
6	E1-04-TXP	21	E1-04-TXN	36	E1-04-RXN
7	CGND	22	E1-04-RXP	37	CGND
8	E1-05-TXN	23	E1-05-TXP	38	E1-05-RXN
9	E1-06-TXP	24	E1-05-RXP	39	E1-06-RXN
10	E1-06-TXN	25	CGND	40	E1-06-RXP
11	E1-07-TXP	26	E1-07-TXN	41	E1-07-RXN
12	E1-08-TXP	27	E1-07-RXP	42	CGND
13	E1-08-TXN	28	E1-08-RXP	43	E1-08-RXN
14	NC	29	CGND	44	NC
15	NC	30	NC		

E1 Switch Network I/F 2 Connector Pin-out (D-sub HD 44-pin)					
Pin	**Signal Name**	**Pin**	**Signal Name**	**Pin**	**Signal Name**
1	E1-09-TXP	16	E1-09-TXN	31	E1-09-RXN
2	E1-10-TXN	17	E1-09-RXP	32	CGND
3	E1-10-TXP	18	E1-10-RXN	33	E1-10-RXP
4	E1-11-TXN	19	CGND	34	E1-11-RXN
5	E1-11-TXP	20	E1-11-RXP	35	CGND
6	E1-12-TXP	21	E1-12-TXN	36	E1-12-RXN
7	CGND	22	E1-12-RXP	37	CGND
8	E1-13-TXN	23	E1-13-TXP	38	E1-13-RXN
9	E1-14-TXP	24	E1-13-RXP	39	E1-14-RXN
10	E1-14-TXN	25	CGND	40	E1-14-RXP
11	E1-15-TXP	26	E1-15-TXN	41	E1-15-RXN
12	E1-16-TXP	27	E1-15-RXP	42	CGND
13	E1-16-TXN	28	E1-16-RXP	43	E1-16-RXN
14	NC	29	CGND	44	NC
15	NC	30	NC		

E1 Switch CLK IN Connector Pin-out (RJ-45)		
Pin	**Signal Name**	**Function**
2, 3	CLK IN	Differential input/output clock signal
1, 4-8	-	-

E1 Switch CLK OUT Connector Pin-out (RJ-45)		
Pin	**Signal Name**	**Function**
2, 3	CLK OUT	Differential input/output clock signal
1, 4-8	-	-

E1 Switch BS A COM, BS B COM pin-out (RJ-45)			
RJ-45 Pins	**Signal Name**		
2	TXD		
3	RXD		
5	GND		
1,4,6-8	-		

E1 Switch IF MUX COM pin-out (RJ-45)			
RJ-45 Pins	**Signal Name**		
2	RXD		
3	TXD		
5	GND		
1,4,6-8	-		

C

Appendix C - Glossary

In This Appendix:

- Glossary of WALKair 3000 terms.

Term	Description
AAU	Antenna Alignment Unit
ASL	Above Sea Level
ATS	Air Time Slot
BER	Bit Error Rate
BRI	Basic Rate Interface
BS	Base Station
BS IDU	Base Station Indoor Unit
BS ODU	Base Station Outdoor Unit
BS-SA	Base Station Stackable architecture
BU	Basic Unit
CPE	Customer Premises Equipment
DDF	Data Distribution Frame
EMI	Electro-Magnetic Interference
ETSI	European Telecommunications Standards Institute
FDD	Frequency Duplexing Division
FEC	Forward Error Correction
IDU	In Door Unit
IF	Intermediate Frequency
IF MUX	Intermediate Frequency Multiplexing units
IFU	Intermediate Frequency Unit
ITU	International Telecommunication Union
LAN	Local Area Network
LCI	Local Craft Interface
LOS	Loss of Signal
Mbps	Mega Bits per Second
MDF	Main Distribution Frame
MHz	Mega-Hertz
MPU	Main Processor Unit
ODU	Out Door Unit
PM	Performance Monitoring
PMP	Point-to-Multi-Point
PR	Packet Radio
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RFU	Radio Frequency Up-converter
RSS	Received Signal Strength
RTTB	Radio To The Building

Term	Description
SME	Small/Medium Enterprise
SNMP	Standard Network Management Protocol
TDMA	Time Division Multiple Access
TS	Terminal Station
TS IDU	Terminal Station Indoor Unit
TS ODU	Terminal Station Outdoor Unit
VAC	Volts Alternating Current
VDC	Volts Direct Current
WLL	Wireless Local Loop

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WALKair™ 3000

Commissioning Guide

About This Guide

The WALKair 3000 Commissioning Guide provides instructions for the personnel who are responsible for the correct commissioning of the WALKair 3000 Base Station and Terminal Station equipment.

The technical engineer should work according to the workflow presented in this guide (in Chapter 1 - Figure 1-1).

Please note that Appendix A Includes frequency tables for the 10.5, 26 and 28 GHz bands.

Safety Precautions

CAUTION

High voltages are present at specific points in this electrical equipment. Some parts may be subjected to high operating temperatures. Non-observance of these conditions and safety instructions can result in personal injury or property damage.

The WALKair system complies with the **EN 60950** standard. All connected equipment must comply with the applicable safety standards.

Equipment complies with the following EMC and safety standards:

- EN 50081-1
- EN 55022
- IEC 100-4-as 2, 3, 4, 5, 6, 8, 11
- ETSI 300339.

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Contents

1

Chapter 1 - Introduction

In This Chapter:

This provides an overview of the system commissioning procedure and introduces the LCI and WALKnet applications that are used in the commissioning process.

System Commissioning Process Overview

The commissioning procedure consists of the following basic stages as illustrated by the flowchart in Figure 1-1:

1. Assigning the IP Address and VLAN definitions (if relevant) to each and every BS-SA in order to enable remote management of the BS-SA and its TSs.

   NOTE: This is done through a **local LCI** connection; the remaining configuration BS-SA procedures may be performed remotely through the WALKnet management application or through a Telnet connection .

2. Commissioning (configuring) the Base Stations (BS):

   NOTE: This procedure includes the configuration of 28 GHz RFU, in installations where this is relevant.

   - Sector parameters
   - BS-SA parameters
   - TSs registration

3. Commissioning the services:
   - Ethernet and E1 port configuration
   - Client definitions
   - Service configuration

4. Commissioning the Terminal Stations (TS):

   NOTE: This procedure includes the configuration of 28 GHz RFU, in installations where this is relevant.

   - Administrative – general and RF parameters (through a local **LCI** connection)
   - RFU parameters (through a local **LCI** connection)
   - Verifying link performance

Figure 1-1 illustrates the commissioning process workflow.

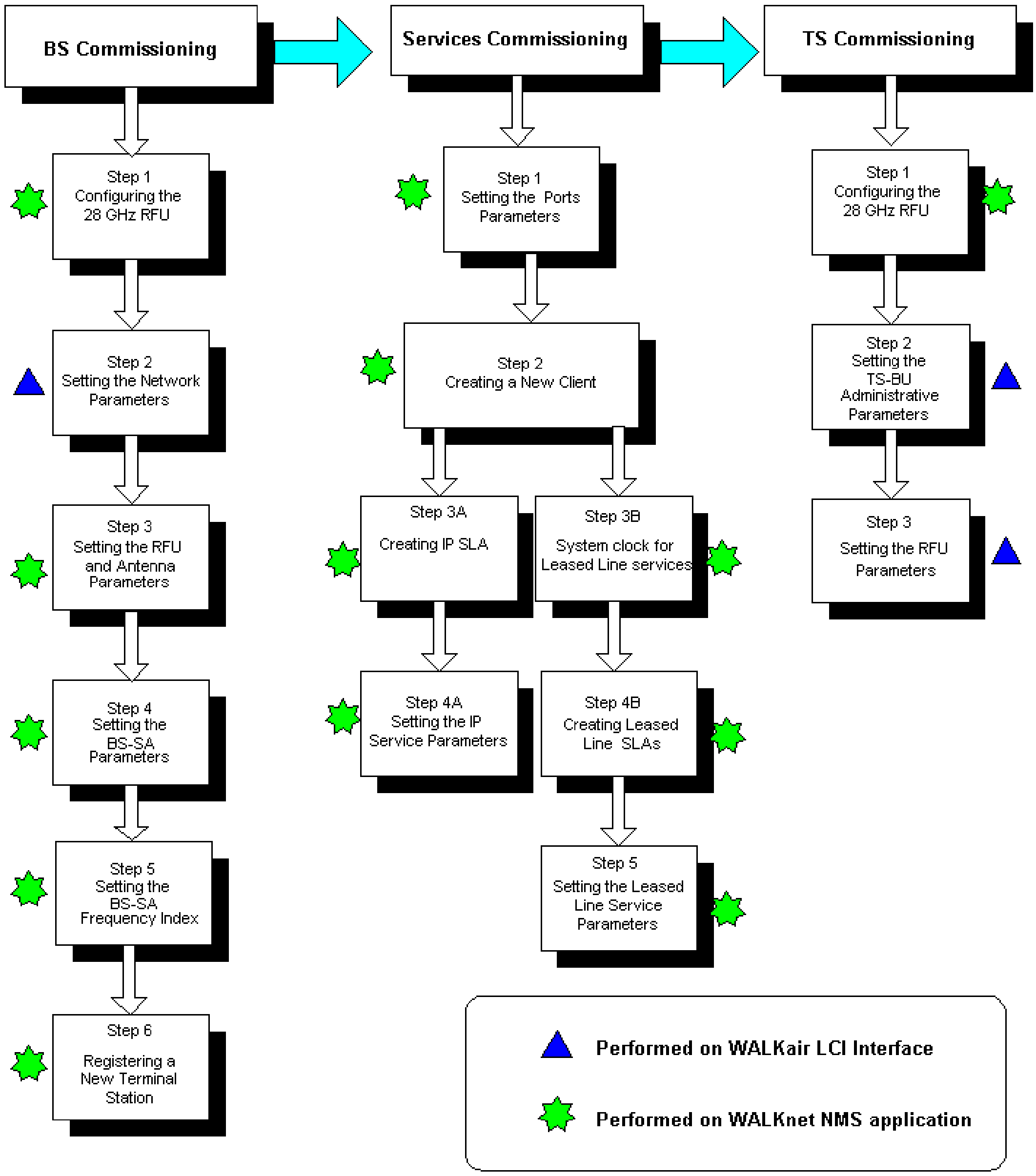

Figure 1-1: Commissioning Process Workflow

Connecting and Navigating LCI

LCI is used for local connection to the BS-SA and TS-BU IDUs. On the BS-SA, LCI is used to configure the network parameters (IP Address and VLAN) and to configure the first authorized administrator; on the TS-BU, LCI is used to configure the administrative and RFU parameters and to verify the link.

LCI can also be used for troubleshooting and some monitoring functions. Other management and monitoring operations are usually performed through WALKnet.

Access to the sessions is acquired through:

- A terminal emulation application such as HyperTerminal, PROCOMM, PCPLUS, etc.
- Through Telnet

Connecting the BS-SA or TS-BU to the LCI

Connect the LCI port on the front panel of the relevant BS-SA or TS-BU to the RS232 port on a computer on which a terminal emulation application (i.e. HyperTerminal, PROCOMM, PCPLUS, etc.) is installed, as illustrated in the following figure.

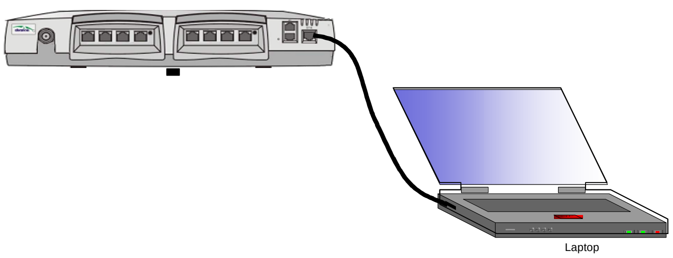

Figure 1-2: Connecting LCI to a BS-SA or a TS-BU

To setup the LCI connection

1. Connect a *standard* RS232 cable (whose pin out is given in the following table) between the computer RS232 port and the **LCI** port of the BS-SA or TS-BU device.

Table 1-1: BS-SA /TS-BU Serial Cable Pin-out			
Signal Name	RJ-45 Pin-out (TS/BS IDU)	D-type 25-pin (PC)	D-type 9-pin (PC)
	1		
RXD	2	2	3
TXD	3	3	2
	4		
GND	5	7	5
	6		
	7		
	8		

2. Launch the terminal emulation application on you computer and set the COM port to the COM settings described in Table 1-2.

Table 1-2: PC COM Port Settings	
Parameter	**Setting**
Bit Rate	9600 bps
Parity	None
Data Bits	8
Stop Bits	1
Protocol Type	ASCII
Duplex	Full duplex

3. To access the network configuration parameters, logon using either the **Tech** or **Admin** User Levels using the **Username** and **Password** provided by your System Administrator, in accordance with your security Level. The available options for each user level are described in the following table.

Table 1-3: LCI Security Levels			
Username	Default Password	Security Level	Permissions
USER	ALVRU	USER	GET menus
TECH	ALVRT	TECH	GET and SET menus Setting USER permissions
ADMIN	ALVRA	ADMIN	GET and SET menus Setting TECH permissions Adding/changing User Passwords

4. At the Terminal window prompt, press **Enter**. The following prompt appears.

```
MPU/L/A> Enter Option No :  *
```

NOTE: If this prompt does not appear, the BS-SA may have an open Telnet session. To close the additional session, press **Esc** on your keyboard.

5. Type asterisk (*) and press **Enter** to display the Help menu.

```
Type The <Symbol><Enter> At Any Time :
*   Main Menu              %   Toggle Error Messages Display
^   Previous Menu          =   Refresh Menu Screen
?   Get Print Modules      $   Get LCI Status
ESC Exit LCI
Main Menu
------------
1. Configuration Menu.
2. Maintenance Menu.
d. Debug Menu.
l. LCI Configuration Menu.
```

6. To access the Networks Parameters definitions, enter **1** (Configuration Menu). The Configuration Menu options appear.

```
Configuration Menu
---------------------
1. BU BS Configuration Parameters Menu.
2. Services Configuration Parameters Menu.
3. TS Configuration Parameters Menu.
4. Sector Configuration Parameters Menu.
5. RFU Configuration Parameters Menu.
7. Authorize Manager Configuration Parameters Menu.
8. Port Configuration Parameters Menu.
9. Network Parameters Menu.
a. Clock Control Menu.
c. IDU Redundancy Parameters Menu
```

7. Enter **9** (Network Parameters Menu). The Network Parameters Menu appears.

```
Network Parameters Menu
--------------------------
1. Get Out Band Management.
2. Set Out Band Management.
3. Remove Out Band Management.
4. Get In Band Management.
5. Set In Band Management.
6. Remove In Band Management.
MPU/L/A> Enter Option No : 1
```

NOTE: The network parameters can be set ***either*** through in-band or out-of-band – ***not both***.

Get, Set and Remove options are provided for in-band and for out-of-band management definitions.

NOTE: To set new definitions (either in-band or out-of-band), the current definitions must first be removed using the corresponding **Remove** option.

8. To view the current definitions:

- Enter **1. Get out band ...** or **4. Get in-band...** (according to the type of management to be defined).

  The VLAN and IP Address definitions of the management port are displayed.

```
        Out Band Management:

        Management Port is UnTagged: Vlan ID = 4000
        Management IP Address: 10.0.6.18:ffffff00
        Default Gateway IP address: 10.0.6.29
        Management MAC Address: 00:03:40:a5:00:02

MPU/L/A> Enter Option No :
```

The information includes Tagged/Untagged status, VLAN ID, IP Address and subnet (under **MNG IP Address**) and the Default Gateway.

The format of the MNG IP Address displays the IP Address followed by a colon and the subnet in Hex format: i.e. 10.0.6.28:ffffff00 where 10.0.6.28 is the IP Address and ffffff00 is the subnet mask.

9. To set or change definitions:

- First remove the current definitions by typing **3. Remove out band....** or **6. Remove in-band...** (as required).
- Enter the new definitions by typing **2. Set out-band...** or **5. Set in-band...** (as required).
- You will be prompted for each parameter.

NOTE: Pay attention to the format of the IP Address and subnet mask: they are on the same line, in different formats, separated by colon (i.e. **10.0.6.28:ffffff00**)

```
MPU/L/A> Enter Option No : 2
MNG port IP Address: (enter parameters or 'q')
        Enter MNG port vlan ID [1 - 4000] ->
        1
        Enter MNG port Tagging: 1.Disable 2.Enable ->
        1
        Enter IP address [xxx.xxx.xxx.xxx:yyyyyyyy] ->
        10.0.6.28:ffffff00
```

After completing the definitions, a summary of the network parameters appears.

```
         Out Band Management:

         Management Port is UnTagged: Vlan ID = 4000
         Management IP Address: 10.0.6.18:ffffff00
         Default Gateway IP address: 10.0.6.29
         Management MAC Address: 00:03:40:a5:00:02

MPU/L/A> Enter Option No :
```

10. If the information is correct, exit the LCI menu.

NOTE: The changes will take effect *immediately*.

11. Configure the first authorized manager through the LCI:

- From the **LCI Main** menu enter **1. Configuration Menu**
- From the Configuration Menu, enter **7. Authorized Manager Configuration Parameters Menu**.
- Define the authorized manager user name and password.

NOTE: Additional authorized managers can then be configured from the WALKnet by logging on using the authorized manager user name and password.

12. You may continue to perform additional commissioning procedures through the WALKnet application.

Logging on to a TS-BU Remotely

If you have already logged on to a Base Station BS-SA, you can remotely log on to one of the Terminal Station TS-BUs connected to it.

NOTE: You must be logged in as an Administrator. See LCI Security Levels on page 1-5.

To log on to a TS-BU remotely

1. In the *Main Menu*, type **l** (lower case L) and then press **<Enter>** to display the *LCI Configuration Menu*.

```
Main Menu
------------
1. Configuration Menu.
2. Maintenance Menu.
1. LCI Configuration Menu

MPU/L/A> Enter Option No : l
```

Figure 1-3: Connecting to a Remote Terminal Station from the BS LCI

2. From the *LCI Configuration Commands Menu*, type **8** (Connect to a Remote Device); then press **<Enter>**.

```
LCI Configuration Commands Menu
----------------------------------
1. Get LCI Configuration Status
2. Set Exit Timeout
3. Add LCI User
4. Delete LCI User
5. Set LCI User Password
6. Set LCI User Default Password
7. Get LCI Users
8. Connect To Remote Device
MPU/L/A> Enter Option No : 8
```

3. At the *Remote BS-SA ID* prompt, type in the number of the BS-SA Station that interfaces the Terminal Station to be accessed, and then press **<Enter>.**

```
LCI Set State:
        Enter Remote BS-SA Id -> 4
        Enter Remote TS Index -> 1
 MPU/C/A> Enter Option No :
        LCI: Remote LCI been successfully connected.
*BS 4 TS 1* LCI: Received Connection Req from RLCI_M.
*BS 4 TS 1* LCI Status:
*BS 4 TS 1* LCI Security Level    = ADMIN
*BS 4 TS 1* LCI State             = Remote LCI - Slave
(RLCI_S)
*BS 4 TS 1* Remote Master IP Addr = 0xa0afefe
*BS 4 TS 1* TSBU/R/A> Enter Option No : =
```

4. At the *Enter Remote TS Index* prompt, type in the Terminal Station Index, and then press **<Enter>.** If access is successful, the following message appears: "*Remote LCI been successfully connected*".
5. To exit the Remote LCI, press #.

WALKnet Network Management System

Except for the initial IP Address and VLAN definitions for each IDU (BS-SA), all other configuration procedures may be performed through the **WALKnet** network management application.

WALKnet provides a graphical representation of the WALKair 3000 system, and enables configuration and maintenance through interactive device views and intuitive monitoring options.

WALKnet runs on Microsoft™ Windows NT (and higher) and UNIX platforms. For a list of system requirements, see the *WALKnet User's Manual.*

Managing W3000 BS-SA System Elements

Management of the WALKair3000 stackable system's Network Elements (BS-SA) is as follows:

- WALKnet is connected to the Management (OUT Band) or Ethernet (In Band) port of the BS-SA and communicates with it via the SNMP protocol over UDP/IP. The SNMP agent residing on the BS-SA provides management capabilities for the WALKair 3000 system.
- The BS-SA communicates with the corresponding TS-BUs via an Alvarion proprietary protocol over an air link. The TS-BU does not have an SNMP agent. Instead, it has a small management kernel that interfaces the BS-SA management kernel using the air-link Embedded Operation Channel (EOC).

WALKnet sends all SNMP queries to the WALKair 3000 BS-SA. The BS-SA encodes the requests and collects the information from the appropriate TS-BUs (if required). This way, configuration and monitoring can be achieved at centralized locations.

Launching the WALKnet Network Management System

The procedure for launching WALKnet varies depending on whether it is installed over HP OpenView or as a standalone application.

- HP OpenView - select **Run_WALKNet** from the HP OpenView *Main* menu.
- Standalone *without* HP OpenView - invoke WALKnet, as described below.

To start WALKnet without HP OpenView on UNIX:

- When WALKnet is installed on UNIX, WALKnet is invoked by activating **Run_WALKnet** from the installation directory.

To start WALKnet without HP OpenView on MS Windows:

1. From the Windows *Start* menu, select **Programs** > **WALKnet** > **WALKnet**. The *WALKnet Login* dialog box is displayed as shown below:

Figure 1**-4: WALKnet Login Dialog Box**

NOTE: This path is the default path, specified during installation.

Access to the WALKair system from WALKnet requires authentication. An administrator user configures the user name and password. The default user name is **admin** and the default password is **ad**.

2. Enter your User Name and Password, and click **OK**.

For more information on WALKnet, see the *WALKnet User Manual.*his page left intentionally blank.

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2

Chapter 2 - BS Commissioning

In This Chapter:

This chapter describes the Base Station commissioning procedures. This consists of:

- 28 GHz RFU configuration – where relevant
- Sector configuration
- BS-SA Parameter configuration
- TS Registration

Step 1: 28 GHz RFU Installations

NOTE: Perform this step **ONLY** if a **28 GHz** system is installed.

28 GHz DW RFUs require configuration. It is obviously easier (and as such recommended) to perform the procedure *before* mounting the device on the mast. Therefore, it is described in the *WALKair 3000 Installation Guide, 28 GHz Base Station ODU Installation Chapter 5 –" Configuring RFU Gain using optional BS-RFU Management Software"*.

However, you may also perform it at this stage according to the instructions in the WALKair 3000 Installation Guide.

Step 2: Sector Configuration

This phase consists of configuring (for each sector) the sector:

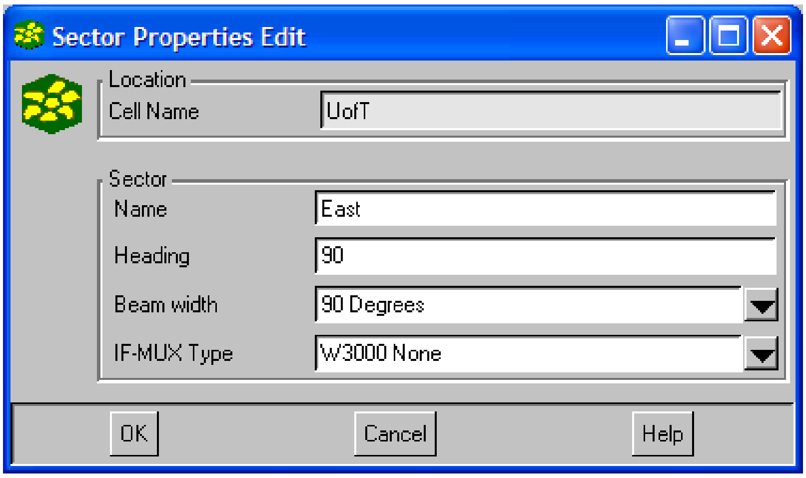
- Properties
- RFU and antenna parameters
- IF Frequency Index

A) Sector Properties

To define the sector properties from the WALKnet

1. From the **Cell View** dialog, select the **Sector** menu and choose **New**. The Sector Properties dialog appears.

NOTE: IF-MUX Type is only available when creating a **new** sector – otherwise it is blocked. To access it again, the sector must be deleted and re-created.



2. Enter the sector **Name,** in the **Heading** box, enter the direction and select the **Beam Width**.
3. Select the IF-MUX type according to the following criteria:

- W3000 De-MUX - BS-SA connected to two sectors
- W3000 None - BS-SA connected to one sector
- W3000 2 ports - IF-MUX II: two indoor units (BS-SAs) as well as Alvarix solution (BS-SA and BS-BU 1000)
- W1K/W3K 4 ports - IF-MUX 4: up to four indoor units to one sector

Table 2-1. IF MUX Attenuation Table

IF MUX Type	Tx Gain [dB]	Rx Gain [dB]	Remarks
W3000 4 Ports 3.5GHz and 10.5GHz bands	1	-2	
W3000 4 Ports 26/28GHz Bands	0	-2	
W3000 4 Ports China Band	-0.5	-2	
W3000 None	0	0	BS-SA
W3000 2 Ports	-4	-4	
W3000 De MUX and Power Feeder	-5	-5	

NOTE: when choosing W3000 4 ports or DE MUX the DC output of the BS-SA is turned off (the IF-MUX 4 or Power Feeder supplies the DC).

B) Sector RFU and Antenna Parameters

The sector configuration defines the RFU and IF parameters, as well as the *redundancy settings and control* for each sector.

In response to a prompt at the completion of the configuration, the parameters are then *broadcast to every BS-SA in the sector.*

NOTE: In order for the BS-SAs in the sector to be updated, they must be disabled (BS-SA Admin status = Disabled).

ATTENION: Be sure to define the parameters correctly since in response to the prompt, they will be broadcast to ALL BS-SAs in the sector. Incorrect RFU and Antenna parameter definitions may result in downtime.

To set the RFU and Antenna Parameters:

1. In the **Sector View** dialog, **Sector** menu select **RFU and Antenna**. The RFU & Antenna dialog appears.

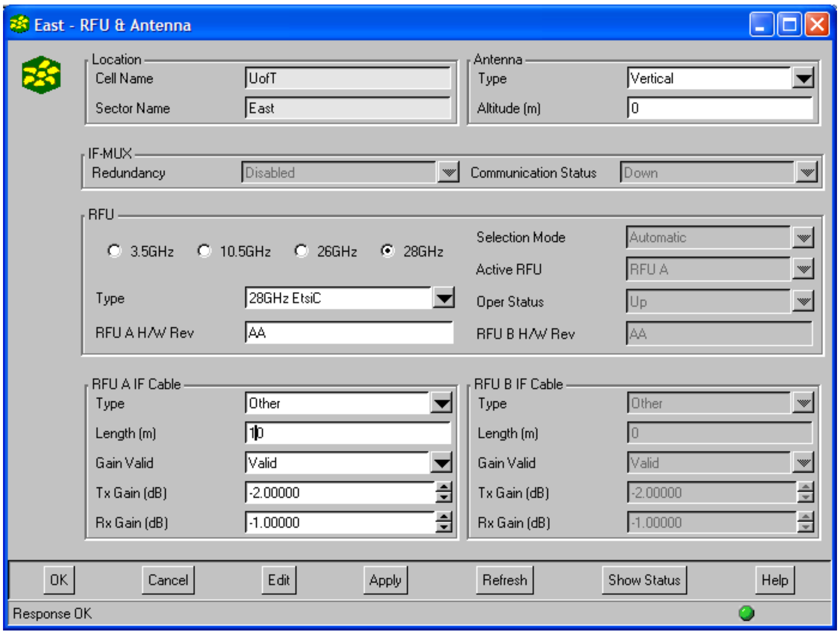


Figure 2-1: RFU and Antenna Parameters

NOTE: Initially, the fields in the RFU and Antenna are enabled. To exit without a change click on **Cancel**.

---

2. Enter the antenna description (for information only):
   - Under **Antenna**, select the antenna **Type:** Vertical, Horizontal or Other.
   - Enter the antenna **Altitude** (in meters).
3. Define the RF parameters:
   - Under **RFU**, select the radio-button corresponding to the RFU type in this sector.
   - Select the **RFU Type** from the available list **–** this defines the type of the outdoor unit in terms of frequency band.

     Refer to the WALKair 3000 System Manual Appendix A - RFU Heads and Operating frequencies for the RFU types and operating frequencies appendix. In the *RFU* area of the RFU and Antenna dialog box
   - In the **RFU H/W version** field for RFU A/B (where relevant), the default value is **AA** (can be left as default)
4. Define the IF cable attenuation parameters for each RFU (A and B if relevant)**:**
   - Under **RFU A IF Cable**, set the **Type** of IF cable as **Other**.

- Type the cable **Length** in meters (this parameter is for *information* only).
- In the **Gain Valid** field, select **Valid.** This indicates that the manually defined Tx Gain and Rx Gain are valid.
- Enter the *measured or calculated* **Tx Gain**: range = –2 to -20 dB
- Enter the *measured or calculated* **Rx Gain**: range = –1 to -12 dB

NOTE: For a system with two IF-MUX II units and WALKair 1000 units, the **Cable Gain = the measured Cable Gain –4 dB**

5. For sector installations supporting RFU redundancy (using IF-MUX 4), configure the redundancy as follows:
   - Under **IF MUX**, set **Redundancy** to **Enabled**.
   - Under **RFU**, set the **Selection Mode:**
     - **Automatic –** active RFU is automatically selected by the system according to the redundancy criteria
     - **Manual –** the RFUs are not automatically switched by the system: the active RFU must be set by the user in the **Active RFU** field.
6. After configuring RFU and ANT press the **Apply** button. You will be prompted with "Broadcast parameters to all devices? "
   - **Yes –** updates all TS-BUs
   - **No –** select to update only *selected* TS-BUs according to the following procedure:
     - A dialog for selecting the devices to be updated is invoked.
     - Click on the **Show** status button and check that the status is *green* meaning update was performed (*red* - no update performed).

C) Sector Frequency Index

Frequency planning enables you to assign frequencies for WALKair 1000 and WALKair 3000 BS-SAs in a sector.

NOTE: BS-SA Admin status must be *disabled* before defining the frequency index.

Frequencies are assigned via the *Sector Frequency Planning* dialog box.

To set the Frequency Index:

1. Invoke the **Sector Frequency Planning** dialog in one of the following ways:
   - From the **Sector View**, **Sector** menu, select **Frequencies.**
   - From the **Main** window, **Configuration** menu, select **Frequencies.** Browse to the required sector in the *Browse Sector* dialog box, and click **OK**.

   The Sector Frequency Planning dialog box appears.

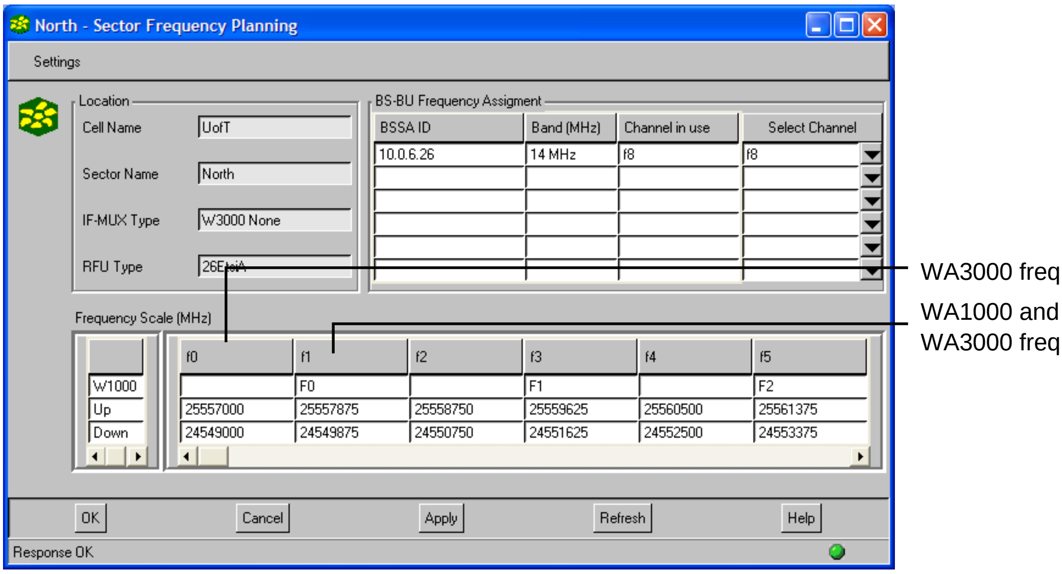


Figure 2-2: Sector Frequency Planning Edit Dialog Box

2. **BS-SA Frequency Assignment** - provides a list of the WALKair 1000 BS-BUs and WALKair 3000 BS-SAs in the sector, and the assigned frequency channels.

   Each unit is described according to its ID, frequency band, the frequency in which it is currently operating (**Channel in Use**). and the selected channel.

   Refer to Commissioning *Appendix A - RFU Heads and Operating Frequencies*.

To select a new frequency index/RF channel number:

Click the **Select Channel** drop-down options and select a new frequency. It will becomes active after the next BS-SA reset.

3. **Frequency Scale** - lists the Uplink and Downlink frequencies (in MHz) for the selected frequency channel. Note the two scales indicated by column headers.
   - **F** (upper case) – frequency rows relevant to WA1000;
   - **f** (lower case) - frequency rows relevant WA3000
4. Click **OK** when you have completed the frequency assignment for the sector.
5. Verify that no BS-SA alarms are displayed.

Step 3: BS-SA Parameters

A) SNMP Trap Destinations

The SNMP trap destinations for each BS-SA are defined through a common dialog in which all BS-SAs are listed. The SNMP trap destinations must be defined for each and every BS-SA.

To set the BS-SA SNMP trap destinations through the WALKnet

1. From the **BS-BU** menu, select **Authorized Managers.** The Authorized Managers dialog with the trap destination management options appears.

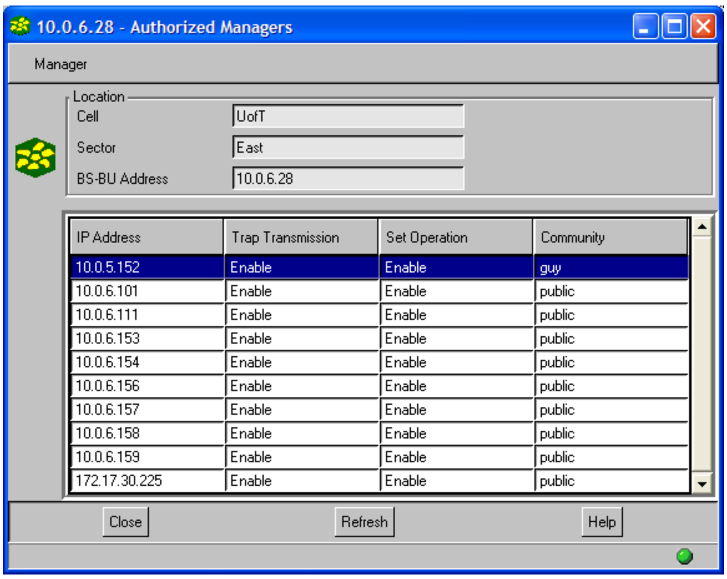


Figure 2-3. Authorized Managers

2. From the **Managers** menu, add a destination address, delete or modify a selected address. You may also double-click on a selected address to modify its definitions. (note: only pre-authorized manager can modify this parameters)

B) BS-SA Global Parameters

To set the BS-SA global parameters

1. In **Sector View**, **Element** menu, select **W3000 BS-SA** and choose **New** from the submenu. The new BS-SA is created and displayed in the selected slot.
2. To start configuring W3000 BS-SA, select **W3000 BS-SA** from the **Element** menu in Sector View, and then select **View**.
3. In **BSSA View** dialog, **BSSA** menu, select RFU and Antenna. The RFU and Antenna Dialog box appears.

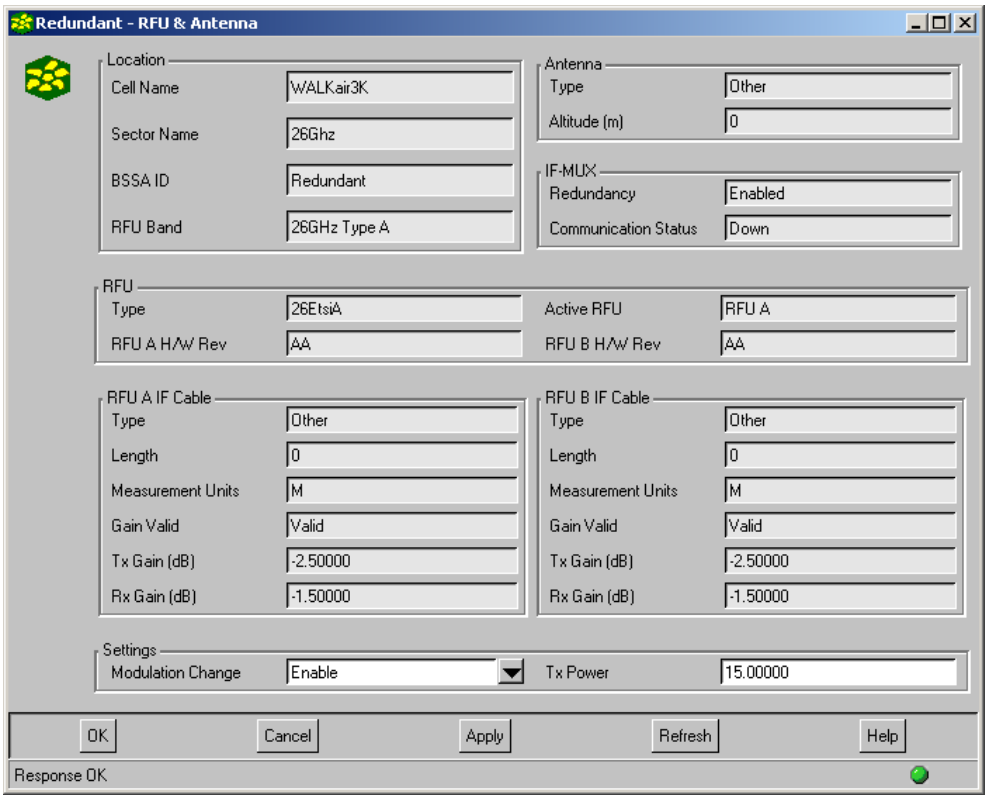


Figure 2-4: BS-SA RFU and Antenna Dialog Box

4. Set the Modulation Change to Enable
5. Set Tx Power default 15 dBm
6. In **BSSA View** dialog, **BSSA** menu, select Edit BS-SA. The BS-SA Parameters Dialog box appears.

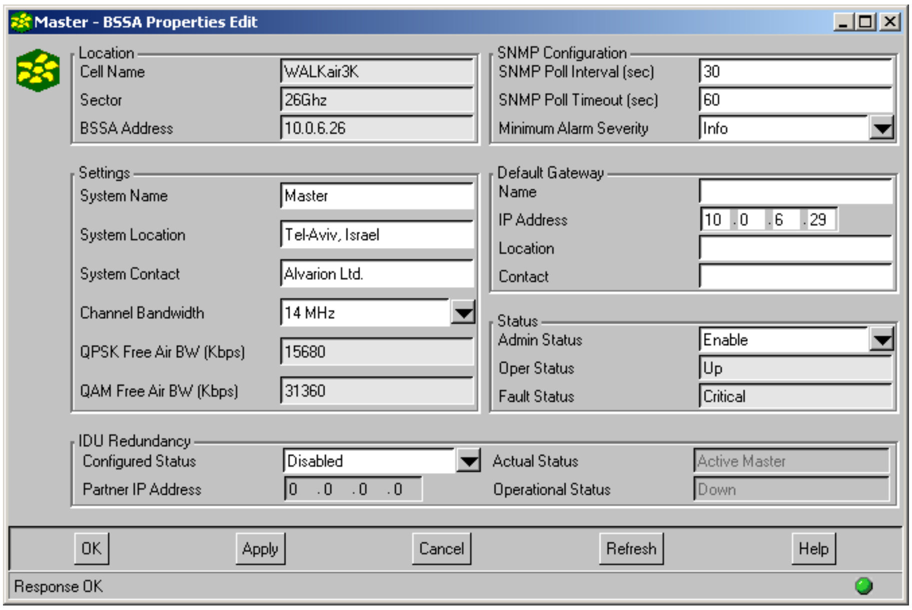


Figure 2-5: BS-SA Parameters

7. Define the system Name. Location and contact are for information only

8. Define the Channel Bandwidth to be used, 14MHz, 7MHZ or 3.5MHz (3.5 MHZ applicable on 10.5GHz Band only).

9. Define the Default Gateway parameters under **Default Gateway** by entering the gateway**:** **Name**, **IP Address**, **Location** and **Contact** information.

10. For installations supporting IDU redundancy (E1 Switch), to configure for IDU redundancy:

NOTE: First, the BS-SA designated as the Master must be defined, and then the BS-SA designated as the Redundant (Slave):

- If this BS-SA is designated as the Master, in the **IDU Redundancy** area, set **Configured Status** to **Master** and in the **Partner IP Address,** enter the IP Address of the Slave.

- If this BS-SA is designated as the Redundant (Master already defined), in the **IDU Redundancy** area, set **Configured Status** to **Redundant** and in the **Partner IP Address,** enter the IP Address of the Master.

11. Change the Admin status to **Enable** in order to enable the BS-SA operation.

12. Click the **OK** button to save any modifications made to the W3000 BS-SA properties.

NOTE: You can re-configure W3000 BS-SA parameters using the *BS-SA Properties Edit* Dialog Box.

Step 4: TS Registration

Each of the TS hosted by a BS-SA must be allocated to the designated BS-SA according to the procedure described in this section.

To register TSs

1. In **BS-BU View** dialog, **BS-BU** menu, select **Registered Terminals**.
2. From the **Terminals** menu, choose **New**. The New Terminal dialog box appears.

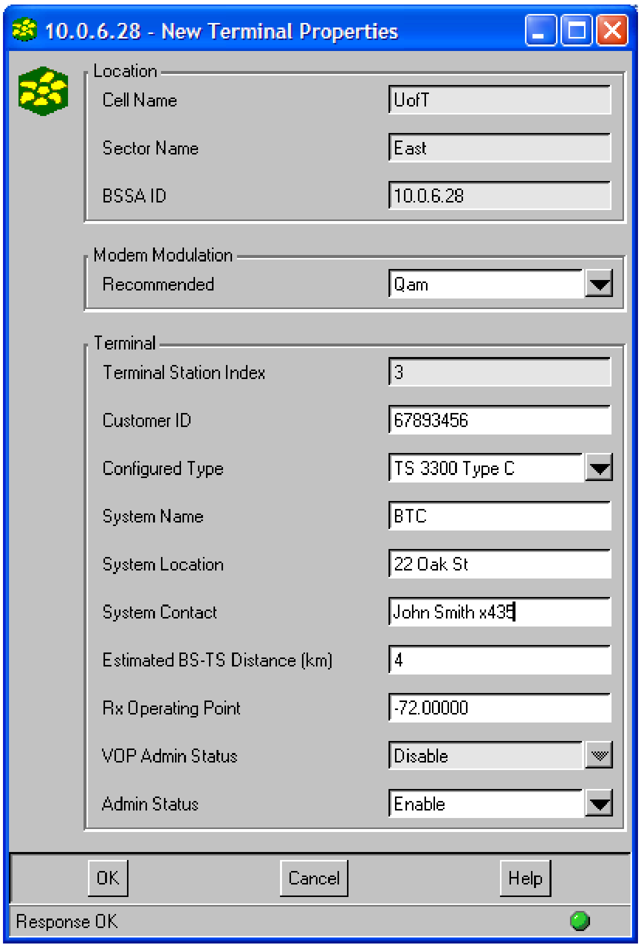


Figure 2**-6: New Terminal Dialog Box**

The **BS-SA ID** shows the designated BS-SA. The **TS index** is a value between **1** and **64** that is sequentially assigned to each allocated TS.

3. Define the **TS customer ID** – up to 8 digit decimal number. The customer ID can only be defined when a new TS is created and cannot be edited later. In the *Terminal* area, enter a number in the *Customer ID* field.
4. Enter the **System Name** (no spaces)**, System Location** and **Contact Information** (optional).

5. Select the **Configured Type** (default = **Not Installed**) according to the following options:
   - TS 3000 Type A - 4 Ethernet ports, 2 E1 ports (supported only up to Version 3.0)
   - TS 3300 Type A - 2 Ethernet ports
   - TS 3300 Type B - 2 Ethernet ports, 4 E1 ports
   - TS 3300 Type C - 2 Ethernet ports, 8 E1 ports
6. Enter the **Estimated TS-BS Distance** - the estimated distance between the BS and TS in kilometers (within ±**2.5km**). Range: 0 to 10 (Km). The default Rx Operating Point (below) is automatically assigned according to the distance.
7. Select the **Rx Operating Point -** target Rx power per TS at the RFU input. The default Rx Operating Point varies depending on the distance (you can manually change the values):
   - Up to 2 Km = -70 dBm
   - 2 to 4 Km = -72 dBm
   - Over 4 Km = -76 dBm
8. Select the **Modem Modulation** (recommended) - modulation of the TS uplink connection and the BS downlink connection. Make the selection according to the link budget calculations.

   Options: **QAM16** and **QPSK**.

   NOTE: If **Modulation Change** is enabled at the BS SA, QAM 16 modulation is automatically changed to QPSK in case of bad link performance.

   If QPSK is selected, the modulation will always be QPSK, even if a modulation change is enabled on the BS-SA.

   ---
9. To activate the TS, set **TS Administrative Status** to **Enable.**

3

Chapter 3 - Service Commissioning

In This Chapter:

This chapter describes the service commissioning procedures. These consist of:

- Physical port configuration
- Defining the clients
- Defining the SLA and service parameters

Step 1: Physical Port Configuration

Begin by configuring the physical port parameters of the Ethernet and E1 ports on the BS-SA and Terminal Station.

NOTE: Except for the identification of the relevant BS-SA or TS-BU, the port configuration dialogs are the same for both – and so only one is described.

Configuring BS-SA and TS-BU Ports

Ethernet Port(s)

The configuration procedure consist of enabling the Ethernet port and, if necessary, changing the communication settings.

NOTE: The **Output VLAN Data** definitions differ in the BS-SA and TS-BU. In the BS-SA it automatically set to Tagged, while in the TS-BU it can be set to Tagged or Untagged.

To configure the Ethernet port:

1. To access the Ethernet Port Configuration dialog:

   From the **BS-SA View** (or **TS-BU View**), double-click the Ethernet interface line (or use the **Port** menu **Edit** function)**.**

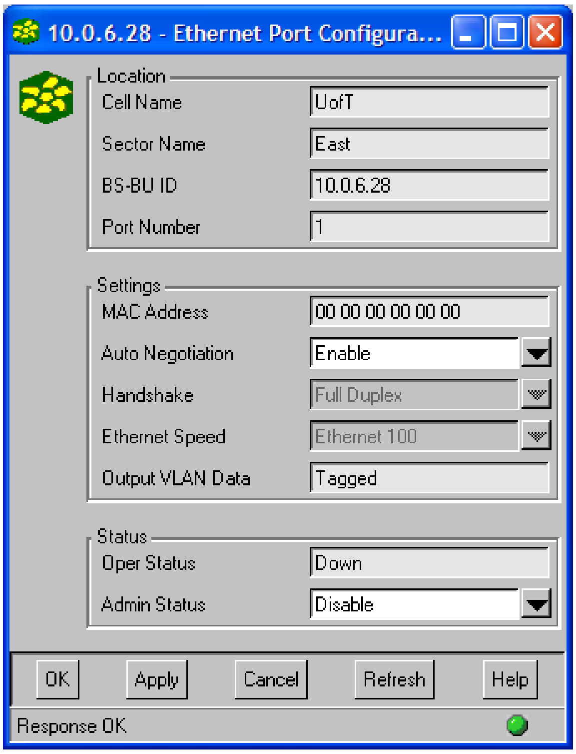


Figure 3-1 W3000 BS-SA Ethernet Dialog Box

2. Set **Auto Negotiation:**

   - **Enable** – (recommended). System automatically identifies the communication mode.

   - **Disable** – disables Auto-negotiation. Requires selecting the communication modes: **Handshake** (Full Duplex, Half Duplex, None) and **Ethernet Speed** (Ethernet 10M, Ethernet 100M).

3. For **TS-BU** only, set the **Output VLAN Data** to Tagged or Untagged **–** this enables or disables VLAN tags on packets entering the LAN:

   - Untagged – single IP service configured to the Ethernet port

   - Tagged – a number of IP service can be configured to the Ethernet port

4. To enable the port, set **Port Administrative Status** to **Enable.**

5. Click **OK**.

E1 Ports

To configure the E1 ports on the BS-SA:

1. Access the E1 Port Configuration dialog:

   From the **BS-SA View** (or **TS-BU View**), double-click the E1 interface line (or use the **Port** menu **Edit** function)**.**

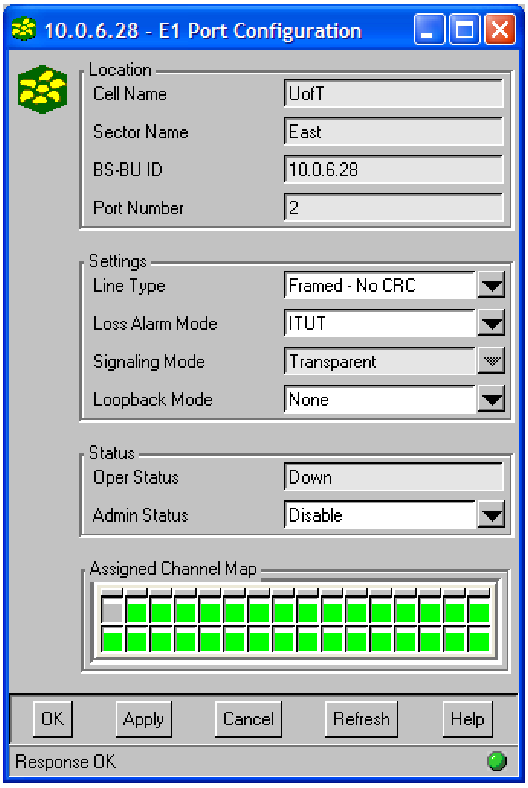


Figure 3-2 W3000 BS-SA E1 Port Configuration

2. Under **Setting**, select the *line type* from available options:
   - **Unframed:** No synchronization on time slot "0" of the E1. The port is synchronized only by clock. Fractional E1 service cannot be configured on this port
   - **Framed-No CRC:** The port is synchronized on time slot "0" of even and odd frames. No Multi-Frame synchronization and CRC are available. Fractional E1 service can be configured for this port.
   - **Framed-CRC4:** The port is synchronized on time slot "0" (zero) of Multi-Frame (16 frames) available CRC4. Fractional E1 service can be configured for this port.
   - **Framed-CRC4 (Ext):** The port will attempt to synchronize on Multi-Frame. If it fails, it will attempt to function as a "Framed-No CRC" port (synchronization on even and odd E1 frames).
3. In *the Settings* area, from the *Loss Alarm* Mode (standard used for loss alarm criteria) drop-down list, select one of the following: **ITUT** or **ETSI**.
4. In the *Settings* area, from the *Signaling Mode* drop-down list, select the *E1 Signalling Mode*: **Transparent**, **CCS** or **None**.
5. In the *Settings* area, from the *Loopback Mode* drop-down list, select the type of loopback applied to the E1 Telecom interface:
   - None – no loopback
   - Remote – in remote loopback testing, the clock and data recovered from the line inputs are routed back to the line outputs via the analog or digital transmitter. This loopback is used for remote self-testing.
   - Local – Local loopback disconnects the Rx lines from the receiver. The data provided b the system interface is routed through the analog receiver back to the system interface. This test is used to check the FALC.
   - Payload – Payload loopback loops the data stream from the receiver path back to the transmitter section. The looped data passes the complete Telecom port receiver including the wander and jitter compensation in the receive elastic store.

NOTE: Refer to the troubleshooting manual for more information on connections and testing in loopback mode.

6. Enable the port by setting the **Administrative Status** to **Enable**.

Step 2: Defining Clients

WALKair 3000 system can support a maximum of 1520 clients, where each TS can support up to 64 user defined clients. Each client is individually defined by a description and contact information.

To add a client

1. From the **BS-BU View**, **Services** menu, select **Clients and Services.**
2. From the **Client List** dialog, **Client** menu, select **Add**. The Add Client dialog box appears:

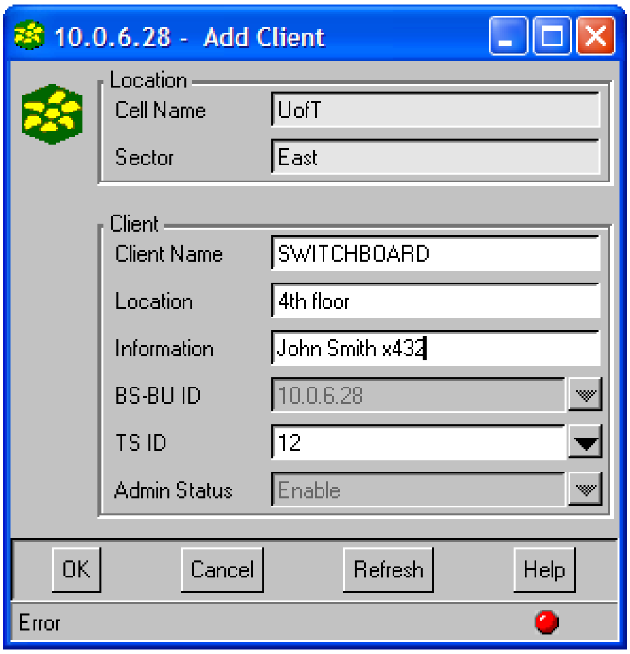


Figure 3-3: Add Client Dialog Box – Stackable BS-SA

3. Define the description and contact information:
   - **Client name** – administratively assigned client name. An alphanumeric string that must begin with at least two *alphabetic* (not numeric) characters. All characters must be in English. The data is converted automatically to uppercase English letters when you press the **OK** button.
   - **Client Location** – reference only. Physical location of the client.
   - **Information –** reference only. Contact information.
4. In the **TS ID** drop-down list, select the TS that will host this client, from the predefined TSs in the list.
5. Click **OK**. The new client is displayed in the *Client List* dialog box.

Step 3: SLA and Service Parameters

Creating and Allocating IP SLAs

The Service Level Agreement (SLA) defines the template of parameter values that is selected during the definition of an IP service for a client.

WALKair 3000 supports up to 1024 IP SLAs per *BS-SA*. As it is created, each SLA is allocated to a specific TS. Up to 16 dedicated SLAs can be allocated to each TS.

Configuration Procedure

To create an IP SLA

1. From the **BS BU View**, **Services** menu select **SLA** and **IP SLA**. The IP SLA list dialog appears.

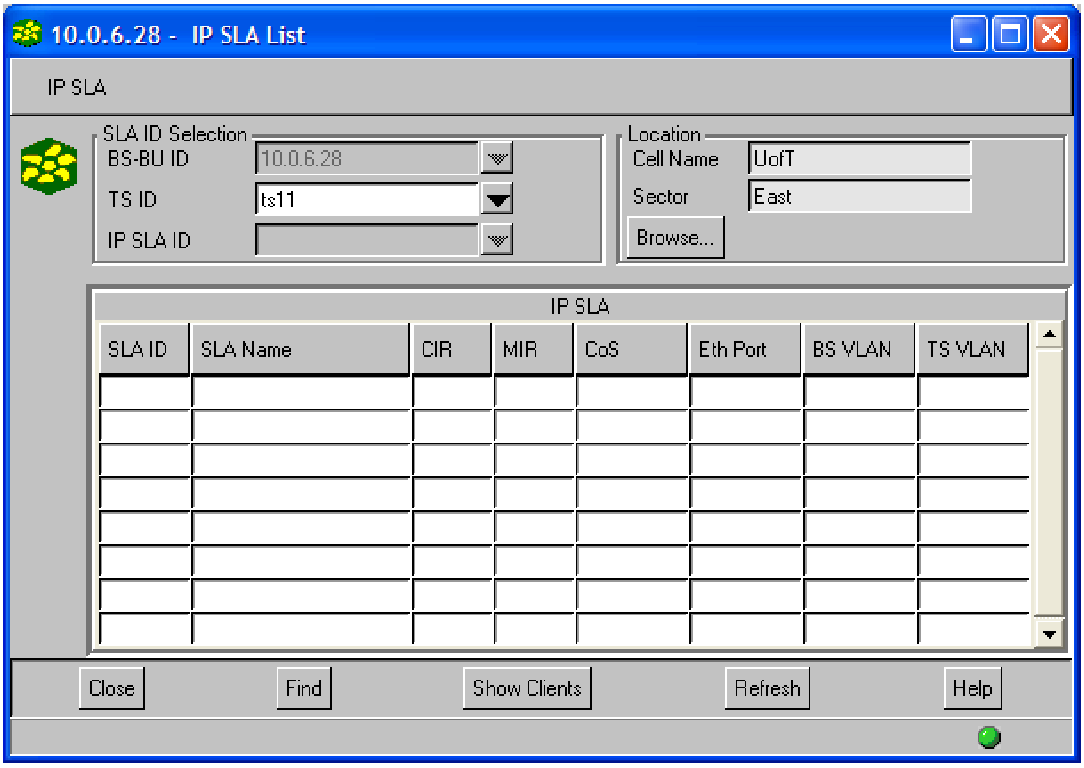


Figure 3-4: IP SLA List Dialog Box

2. In the **TS ID** field, select the TS to which the SLAs will be allocated.

NOTE: Until IP SLAs are allocated to the current BS-SA and selected TS, the **IP SA ID** field will be disabled. To discover allocated SLAs, click **Find.**

3. The From the *IP SLA* menu, select **Add**. The Add IP SLA dialog box is displayed with the next available sequential IP SLA ID as shown below.

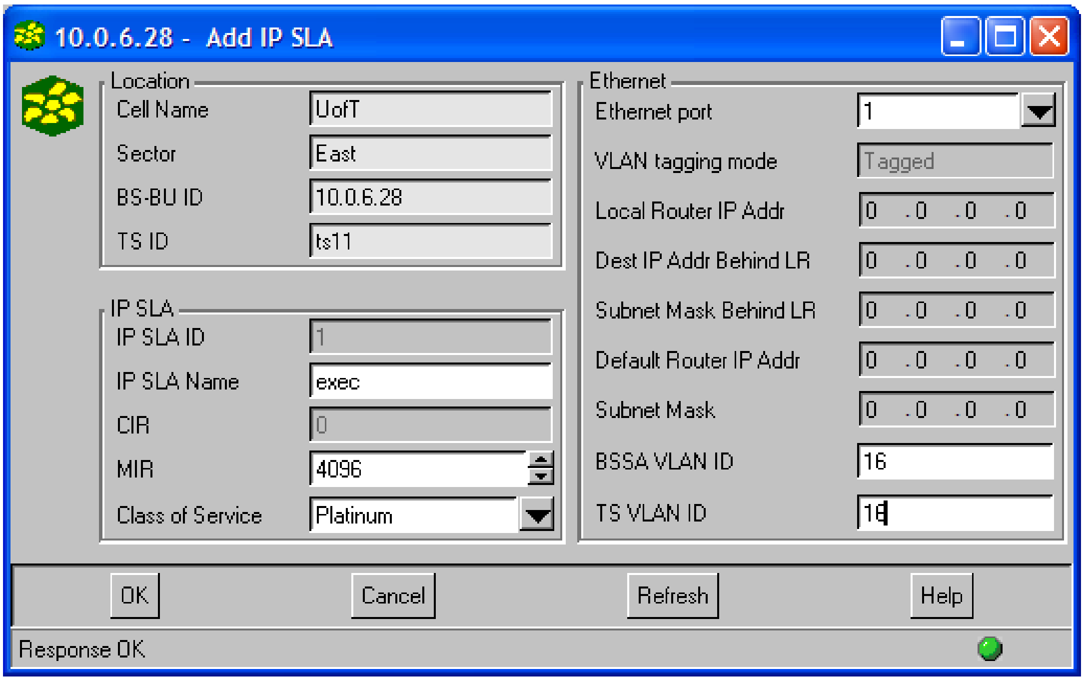


Figure 3-5: Add IP SLA Dialog Box

4. Enter the BS VLAN ID and TS VLAN ID (usually BS and TS VLAN IDs are the same).

NOTE: VLAN tag value range is 1 to 3997, where BS VLAN ID is unique per BS-SA and TS VLAN ID is unique per TS. The BS VLAN should be different than the Management VLAN.

5. In the **IP SLA Name** box, assign the new SLA an identifiable name.
6. Set the **MIR (Maximum Information Rate) -** the *maximum* rate obtainable from this pipe with no bandwidth limitations.

   Value = multiple of 256 Kbps (N*256 Kbps).
7. Select **Class of Service** - defines the SLA class of service. Refer to the *System Description* for CoS descriptions.

Setting the IP Service Parameters

After configuring a client and IP SLA, the IP Service that links the client and IP SLA must be configured.

An IP service with the SLA assigned to each client must be defined. Up to 16 services of different (predefined) IP SLAs can be defined for a client.

To set up the IP Service parameters:

1. From the **BS-SA View**, **Services** menu, select **Clients and Services**. The **Client List** dialog appears.

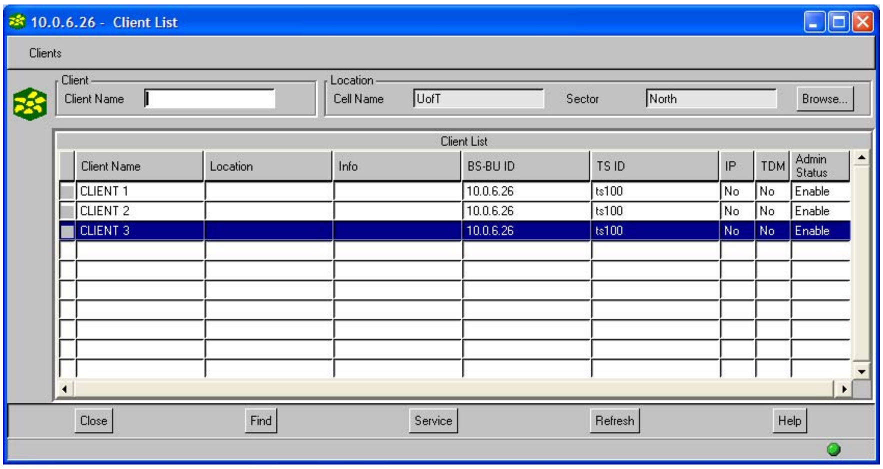


Figure 3-6: Client List Dialog

2. In the **Client List**, select a client (enter "*" or enter the **Client Name** and click **Find**), and click the **Service** button. The Service List dialog appears.

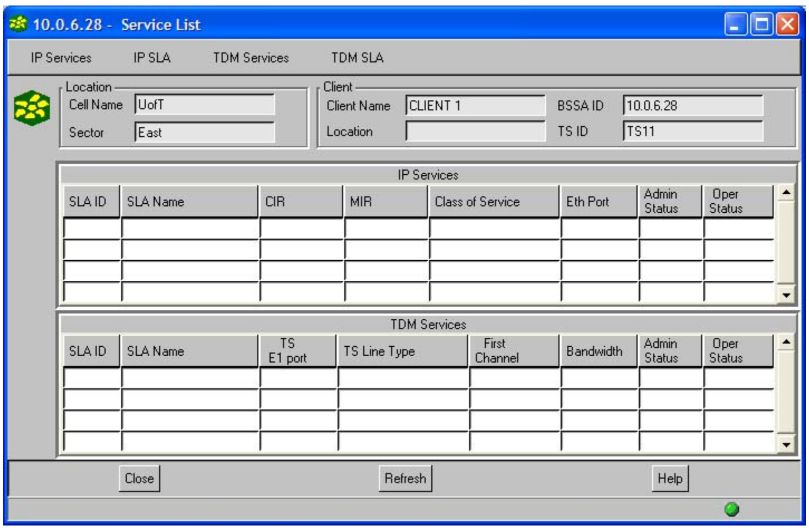


Figure 3-7. Service List dialog

3. In the **IP Services** menu, select **Add.** The Add IP Service Dialog Box appears.

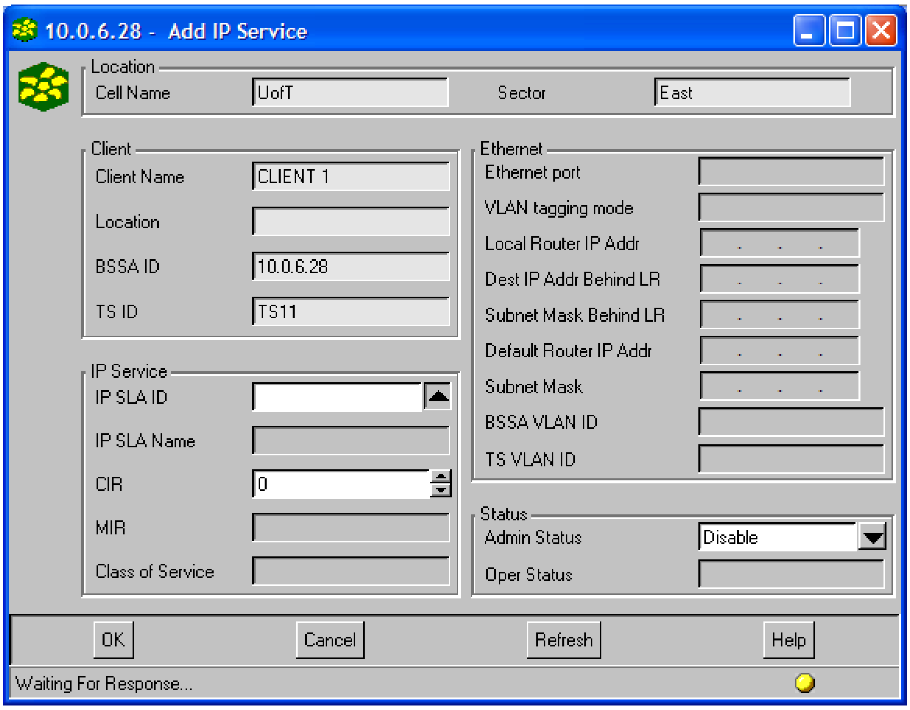


Figure 3-8: Add IP Service Dialog Box

4. Under **IP Service** set the following**:**

- **IP SLA ID** – select from the pool of predefined SLAs allocated to this TS
- **CIR** - Committed Information Rate for all IP traffic. Enter the CIR value as a multiple of 256 Kbit/sec (N*256 Kbps).

NOTE: For a Bronze SLA, the CIR must be set to "**0**". The CIR cannot exceed the maximum MIR in QAM and QPSK.

5. The Service Administrative Status parameter defines the Service status. To activate the service, set this parameter to **Enable**.

6. Click **OK**.

Creating Leased Line (TDM) SLA

WALKair 3000 supports up to 1024 TDM SLAs per BS-SA. The user can create and allocate to dedicated 16 TDM SLA for a specific TS.

1. Invoke the TDM SLA list dialog in one of the following ways:
   - From the **BS-SA View**, select **Services, SLA, TDM SLA.**
   - From the Main window, Configuration menu, *W3000 Services, SLA*, and finally *TDM SLA.* Browse to the required BS-SA and click **OK**. The *TDM SLA List* dialog box appears.

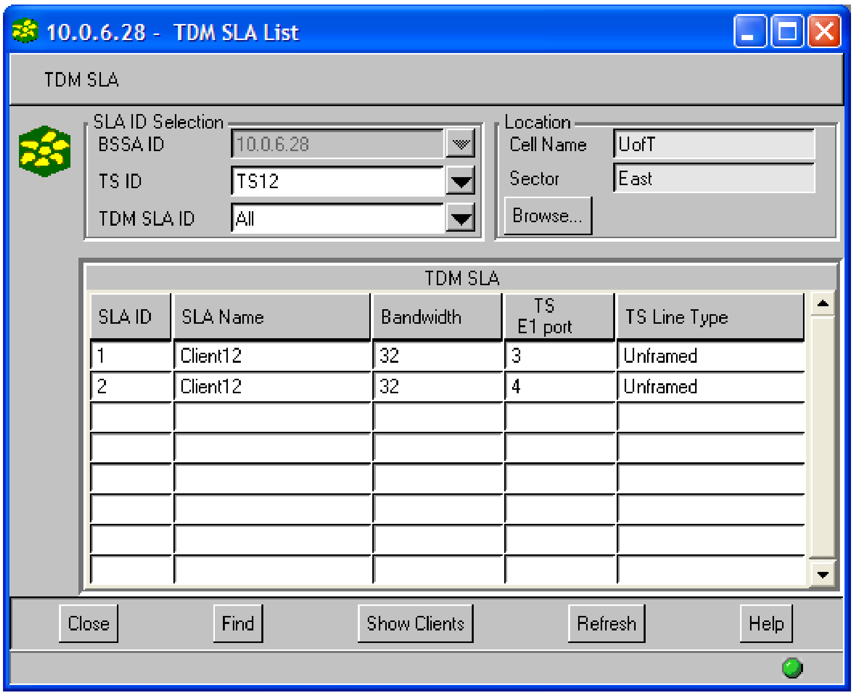


Figure 3-9: TDM SLA List Dialog Box

2. Select the **TS ID** to which this SLA is allocated.
3. Select the **TDM SLA ID** – the ID of the SLA allocated to the TS.

NOTE 1: The **TDM SLA ID** field is disabled when there are no TDM SLAs on the selected BS-SA and TS.

NOTE 2: Click **Find**, to list any TDM SLAs currently defined on the selected BS-SA and TS.

4. A new TDM SLA can now be added for the BS-SA and TS-BU:
   - From the TDM *SLA* menu, select **Add**.
   - The Add *TDM SLA* dialog box appears.

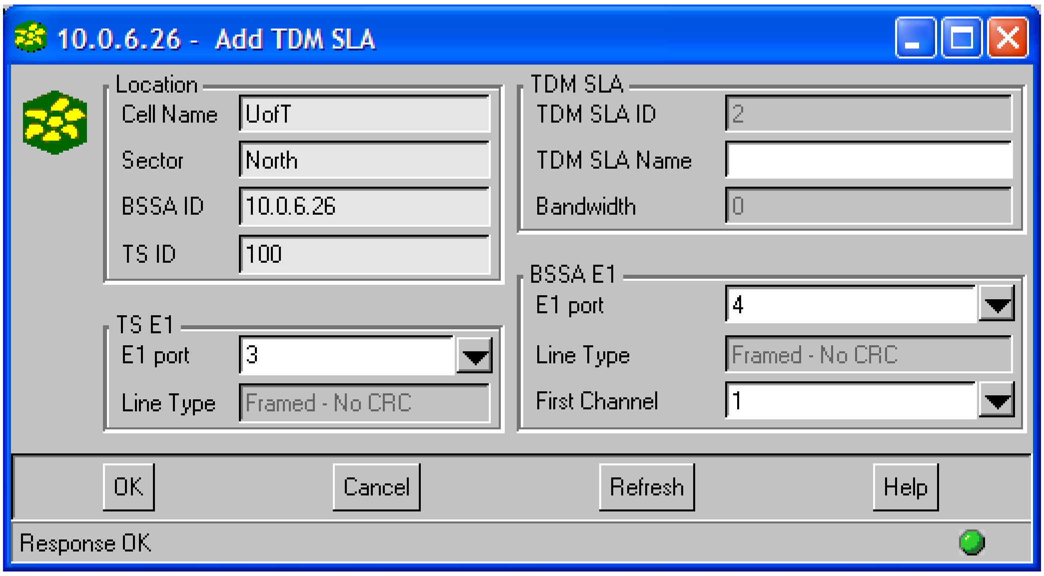


Figure 3-10: Add TDM SLA Dialog Box

5. Enter the **TDM SLA Name** in the *TDM SLA* area,
6. In the *BS-SA/SA E1* area, select the **E1 port**. The E1 port/interface number is required to define the service connection path. This number ranges from 2 to 9 and depends on the BS-SA interface:
   - BS-SA Type B – 2-5
   - BS-SA Type C – 2-9
7. In the *BS-SA/SA E1* area, select the **First Channel** (this is the E1 time slot: 1-31).

Setting the TDM Service Parameters

After configuring a client and TDM SLA, the TDM Service that links the client and TDM SLA must be configured.

To set up the TDM Service parameters:

1. Access the *Client list* dialog box in one of the following ways:
   - In BS-SA View, select **Clients and Services** from the *Services* menu.
   - In the Main window - select **Clients and Services** from the *W3000 Services* submenu of the *Configuration* menu. Browse to the required BS-SA and click **OK**.
2. Access the Service list dialog box from the *Client list* dialog box in one of the following ways:
   - In the *Client List* dialog box, select a client in the client table and click the **Service** button.

- In the *Show Clients* dialog box, select a client in the client table and click the **Service** button.

The *Service list* dialog box is displayed as shown below:

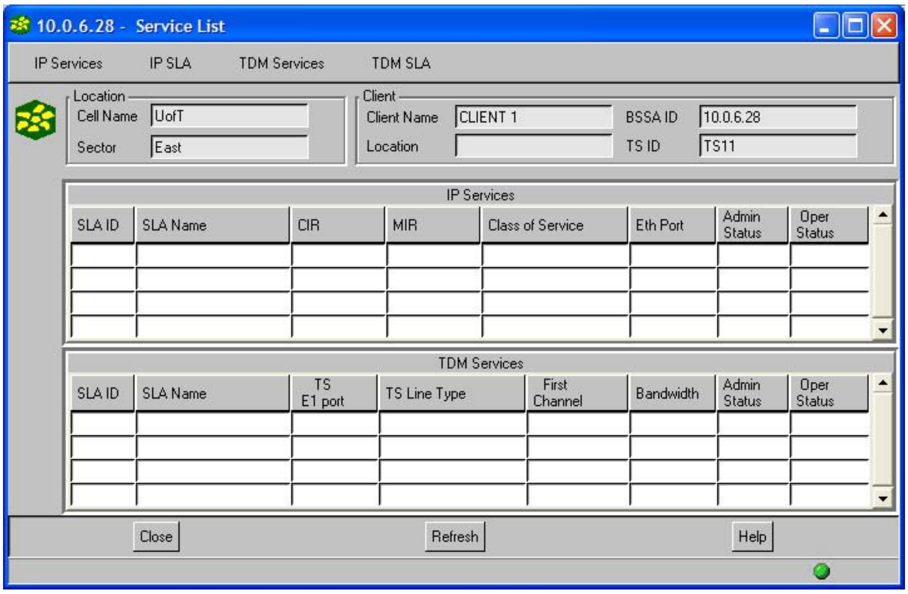


Figure 3-11: Service List Dialog Box

A TDM service with the SLA assigned to each client must be defined. Up to 16 services of different LL SLAs can be defined for a client.

The **TDM SLA ID** assigns the TDM SLA to the service. The **TDM SLA** parameters were previously defined.

3. In the *Service List* dialog box, from the *TDM Services* menu, select **Add**. The *Add TDM S*ervice dialog box appears.

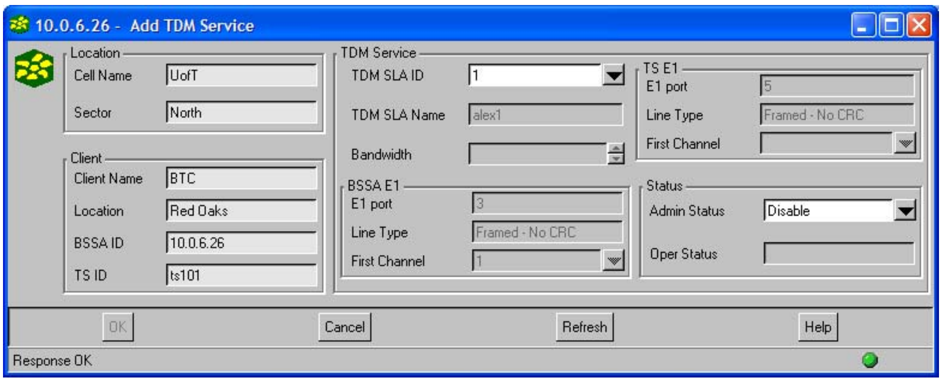


Figure 3-12: Add TDM Service Dialog Box

The *First E1 channel* defines the first **E1 time slot** of the TS E1 port. The service will reside in this time slot and the following time slots according to the defined bandwidth.

The *Service Bandwidth* defines the service bandwidth. Enter the value of the service bandwidth as a multiple of **N*64kbps**.

NOTE: If the E1 port is configured as **unframed**, "the **First E1 Channel**" and "**Service Bandwidth**" fields are grayed.

4. In the *TDM Service* area, from the *First Channel* drop-down list, select the first channel.
5. In the *TDM Service* area, use the up/down buttons to enter the bandwidth.
6. The Service Administrative Status parameter defines the service status. To activate the service, set this parameter to **Enable**.
7. Click on **OK**.

Setting System Clock for Leased Line (TDM) Services

Two types of system clock settings are available:

- **Internal** – BS-SA internal clock
- **Telecom** – external from one of the BS-SA leased line (TDM) ports

1. From the **BS-SA View** dialog, **BS-SA** menu, choose **BS-SA Clock Configuration.** The BS-SA Clock Configuration dialog appears.

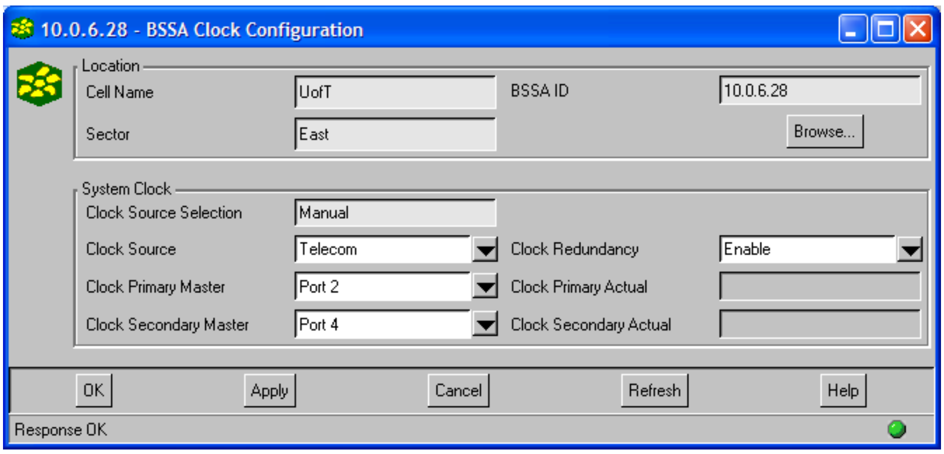


Figure 3-13 BS-SA Clock Configuration

2. Select the clock source from the **Clock Source** field dropdown list, as one of the following:

- **Internal** – BS-SA internal clock.
- **Telecom** – clock source from E1 port.

3. If **Telecom** clock source is selected, in the **Clock Primary Master** field, assign any *enabled* E1 port that is in Up status.

4. If **Telecom** clock source is selected, you may configure an additional clock source. The secondary clock source is enabled if the primary clock source becomes unavailable.

   To configure Clock Redundancy:

   - Set the Clock Redundancy field to Enable.
   - In the **Clock Secondary Master** field, choose any *enabled* E1 port that is in Up status.

5. Click on **OK** to save any modifications made to the BS-SA properties.

3

Chapter 4 - TS Commissioning

In This Chapter:

This chapter describes the TS commission procedure. This includes:

.

Step 1: Configuring the 28 GHz DW RFU

See the *WALKair 3000 Installation Guide, Chapter 10 (28 GHz Terminal Station ODU Installation) – "Adjustment using optional TS-RFU Management Software"*.

NOTE: Perform this step **ONLY** if a **28 GHz** system is installed.

Step 2: Setting the TS-BU Administrative Parameters

The TS-BU administrative parameters consist of the:

- TS customer ID – must have the same value as the value registered at the BS-SA
- TS administrative status

To set the Customer ID number:

1. In the **Administrative Parameters Menu** [path: MM/1/2], type **2** and press **Enter**. The current customer ID is displayed as shown in Figure 4-1:

```
TS->> Enter Option No: 2
Enter Customer ID -> 3 44
```

Figure 4-1: Customer ID Screen

2. Enter the TS **Customer ID** (up to 8 digit decimal number unique to the host BS-SA) and press **Enter**.
3. To save the configuration in the Flash memory, type **5** and press **Enter**.
4. To enable the TS BU, type **3** and press **Enter**.

Step 3: Setting the TS RFU Parameters

The **RFU Head Type** parameter defines the type of the outdoor unit - each type operating at a different frequency band. For the list of the different RFU types and their operating frequencies, see *Appendix A, RFU heads and Operating Frequencies*.

The **Cable Gain** parameter provides the values of the IF cable gain. The system automatically adjusts its RF working point according to the value of the cable gain parameter. The range of the transmit cable gain is **–2** dB to **–20** dB. The range of the receive cable gain is **–1** dB to **–12** dB.

The **RF frequency start/stop index** parameter indicates the index of the frequency, from which the TS will start/stop scanning. To reduce the time of the frequencies scanning, the system operator can limit the range of the frequency scan by changing the default **RF frequency stop index**.

To set the RF Head type parameters:

1. In the **RFU Parameters Menu** [path: MM/1/1], type **1** and press **Enter**. The screen shown in Figure 4-2 appears.
2. Enter the **RFU Head Type** and press **Enter**.

```
TS->> Enter option No: 1
Enter RFU Head Type -> TS26EtsiAT526Ets1B
The Entered RFU Head Type is -> TS26EtsiB
```

Figure 4-2: Setting the RFU Parameters

NOTE: To view the available RFU head types, type **7** and press **Enter**

To set the RF Frequency Stop Index:

1. In the **RFU Parameters Menu** [path: MM/1/1], type **3** and press **Enter**. The screen shown in **Figure 4-3** appears.
2. Enter the **RF Frequency Stop Index** and press **Enter**.

```
TS->> Enter Option No: 3
RF Frequency End Index -> 248240
```

Figure 4-3: Setting the RF Frequency Stop Index

NOTE 1: Change this parameter only if you need to reduce frequency-scanning time by limiting frequency range.

NOTE 2: To restore the default values for a specific RFU type, 'set RFU head type' option should be used and the desired head type should be typed in explicitly (even if there is no change in the head type value itself).

To set the Rx Cable Gain:

1. In the **RFU Parameters Menu** [path: MM/1/1], type **4** and press **Enter**. The following prompt appears.

```
TS->> Enter Option No: 4
Cable Gain RX -> -2.000000-5
```

Figure 4-4: Setting the Rx Cable Gain

2. Referring to Table A-1. IF Frequency Range, enter the Rx Cable Gain and press **Enter**.

To set the Tx Cable Gain:

1. In the **RFU Parameters Menu** [path: MM/1/1], type **5** and press **Enter**. The screen shown in Error! Reference source not found. appears.

2. Referring to Table A-1. IF Frequency Range, enter the Tx Cable Gain and press **Enter**.

```
TS->> Enter Option No: 5
Cable Gain TX -> -3.000000-7
```

3. Save the configuration by typing **a** and pressing **Enter**.

4. Reset the TS-BU according to the following procedure:

   - From the LCI Main Menu select 2. Maintenance Menu

```
Main Menu
------------
1. Configuration Menu.
2. Maintenance Menu.
3. Test Menu.
l. LCI Configuration Menu.
TSBU/L/A> Enter Option No : 2
WALKair 3000 – TS
```

   - From the LCI **Maintenance Menu**, select **4. Reset TS** and respond with **Yes** to the verification prompt.

```
Maintenance Menu
-------------------
1. Get Current S/W Version.
2. Get Backup  S/W Version.
3. Switch & Reset TS.
4. Reset TS.
5. Alarm Control Menu.
TSBU/L/A> Enter Option No : 4
Are you sure you want to reset TS (yes/no) ->yes
```

Air Link Status

Verify the link status and link budget according to the following procedure:

1. Access the LCI **Main** menu.

```
Main Menu
------------
1. Configuration Menu.
2. Maintenance Menu.
3. Test Menu.
l. LCI Configuration Menu.

TSBU/L/A> Enter Option No : 3
```

2. Choose **3. Test Menu.** The Test Menu appears.

```
Test Menu
------------
2. TS   Test Menu.
3. Port Test Menu.
```

3. Select **2. TS Test Menu.** The TS control Menu appears.

```
TS Control Menu
------------------
1. TS Status.
2. Start Display Airlink Parameters.
3. Stop  Display Airlink Parameters.
```

4. From the **TS Test** menu, select **2. Start display Airlink parameters**, and then choose **Single print** (single display). The following screen appears.

NOTE: Refer to the Troubleshooting Manual for more information.

```
Fr:7K57594033875322
 RXM:12  (008)   - RX_SYNC
 RLC:8  (008,ON)   - DATA_SYNC
Channel BW:14MHz
EQU SNR [db]:+30.549407
TRUE SNR [db]:+30.081726
Init Gain:.499969
FER,Raw BER [ber]:0,< 0*E -3
RX curr. mod.:QAM16
RX Max. mod.:QAM16
Power [db]:-13.904388
RX gain [db]:-31.949890
Coarse AFC [khz]:-25.930180
Timing Error [deg]:+1.499462
Ph-Loop Freq [khz]:+0.455932
Ti-Loop Freq [KHz]:-2.405548
Ant RX pwr [dbm]:-62.279632
Ant TX pwr [dbm]:+7.799987
ALT. pos:26
```

A

Appendix A - WALKair Operating Frequencies

In This Appendix:

- Frequency Band Tables for the 10.5, 26 and 28 GHz bands.
- IF Frequencies

IF Frequency Range

Table A-1. IF Frequency Range

	BS				TS			
	Tx		Rx		Tx		Rx	
	Start	Stop	Start	Stop	Start	Stop	Start	Stop
10.5GHz system	1000	1150	650	800	1000	1150	650	800
26GHz system	1666	1792	658	784	1680	1806	672	798
28GHz system	1491	1701	483	693	483	693	1491	1701

Frequency Band Tables

Table A-2: WALKair 3000 Frequency Bands

Band	Downlink Band [MHz]	Uplink Band [MHz]	Reference
10.5 GHz	10157.250-10292.875	10507.250-10642.875	**Table A-3**
26GHz ETSI A	24549.000-24661.000	25557.000-25669.000	**Table A-4**
26GHz ETSI B	24633.000-24773.000	25641.000-25781.000	**Table A-5**
26GHz ETSI C	24773.000-24885.000	25781.000-25893.000	**Table A-6**
26GHz ETSI D	24885.000-24997.000	25893.000-26005.000	**Table A-7**
26GHz ETSI E	24969.000-25109.000	25977.000-26117.000	**Table A-8**
26GHz ETSI F	25109.000-25221.000	26117.000-26229.000	**Table A-9**
26GHz ETSI G	25221.000-25333.000	26229.000-26341.000	**Table A-10**
26GHz ETSI H	25333.000-25445.000	26341.000-26453.000	**Table A-11**
26GHz CHINA A0	24507.000-24619.000	25757.000-25869.000	**Table A-12**
26GHz CHINA A1	24619.000-24731.000	25869.000-25981.000	**Table A-13**
26GHz CHINA B1	24731.000-24843.000	25981.000-26093.000	**Table A-14**
26GHz CHINA A2	24843.000-24955.000	26093.000-26205.000	**Table A-15**
26GHz CHINA A3	24955.000-25067.000	26205.000-26317.000	**Table A-16**
26GHz CHINA B2	25067.000-25179.000	26317.000-26429.000	**Table A-17**
26GHz CHINA C12	25179.000-25291.000	26429.000-26541.000	**Table A-18**
26GHz CHINA C34	25291.000-25403.000	26541.000-26653.000	**Table A-19**
26GHz CHINA B3	25403.000-25515.000	26653.000-26765.000	**Table A-20**
28 GHz ETSI C	27996.500-28220.500	29004.500-29228.500	**Table A-21**
28 GHz ETSI D	28192.500-28444.500	29200.500-29452.500	**Table A-22**

Table A-3: 10.5 GHz Frequency Band (Indexes 8-87)								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
8	10157.250	10507.250	60	10202.750	10552.750	112	10248.250	10598.250
9	10158.125	10508.125	61	10203.625	10553.625	113	10249.125	10599.125
10	10159.000	10509.000	62	10204.500	10554.500	114	10250.000	10600.000
11	10159.875	10509.875	63	10205.375	10555.375	115	10250.875	10600.875
12	10160.750	10510.750	64	10206.250	10556.250	116	10251.750	10601.750
13	10161.625	10511.625	65	10207.125	10557.125	117	10252.625	10602.625
14	10162.500	10512.500	66	10208.000	10558.000	118	10253.500	10603.500
15	10163.375	10513.375	67	10208.875	10558.875	119	10254.375	10604.375
16	10164.250	10514.250	68	10209.750	10559.750	120	10255.250	10605.250
17	10165.125	10515.125	69	10210.625	10560.625	121	10256.125	10606.125
18	10166.000	10516.000	70	10211.500	10561.500	122	10257.000	10607.000
19	10166.875	10516.875	71	10212.375	10562.375	123	10257.875	10607.875
20	10167.750	10517.750	72	10213.250	10563.250	124	10258.750	10608.750
21	10168.625	10518.625	73	10214.125	10564.125	125	10259.625	10609.625
22	10169.500	10519.500	74	10215.000	10565.000	126	10260.500	10610.500
23	10170.375	10520.375	75	10215.875	10565.875	127	10261.375	10611.375
24	10171.250	10521.250	76	10216.750	10566.750	128	10262.250	10612.250
25	10172.125	10522.125	77	10217.625	10567.625	129	10263.125	10613.125
26	10173.000	10523.000	78	10218.500	10568.500	130	10264.000	10614.000
27	10173.875	10523.875	79	10219.375	10569.375	131	10264.875	10614.875
28	10174.750	10524.750	80	10220.250	10570.250	132	10265.750	10615.750
29	10175.625	10525.625	81	10221.125	10571.125	133	10266.625	10616.625
30	10176.500	10526.500	82	10222.000	10572.000	134	10267.500	10617.500
31	10177.375	10527.375	83	10222.875	10572.875	135	10268.375	10618.375
32	10178.250	10528.250	84	10223.750	10573.750	136	10269.250	10619.250
33	10179.125	10529.125	85	10224.625	10574.625	137	10270.125	10620.125
34	10180.000	10530.000	86	10225.500	10575.500	138	10271.000	10621.000
35	10180.875	10530.875	87	10226.375	10576.375	139	10271.875	10621.875
36	10181.750	10531.750	88	10227.250	10577.250	140	10272.750	10622.750
37	10182.625	10532.625	89	10228.125	10578.125	141	10273.625	10623.625
38	10183.500	10533.500	90	10229.000	10579.000	142	10274.500	10624.500
39	10184.375	10534.375	91	10229.875	10579.875	143	10275.375	10625.375
40	10185.250	10535.250	92	10230.750	10580.750	144	10276.250	10626.250
41	10186.125	10536.125	93	10231.625	10581.625	145	10277.125	10627.125
42	10187.000	10537.000	94	10232.500	10582.500	146	10278.000	10628.000
43	10187.875	10537.875	95	10233.375	10583.375	147	10278.875	10628.875
44	10188.750	10538.750	96	10234.250	10584.250	148	10279.750	10629.750

Table A-3: 10.5 GHz Frequency Band (Indexes 8-87)								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
45	10189.625	10539.625	97	10235.125	10585.125	149	10280.625	10630.625
46	10190.500	10540.500	98	10236.000	10586.000	150	10281.500	10631.500
47	10191.375	10541.375	99	10236.875	10586.875	151	10282.375	10632.375
48	10192.250	10542.250	100	10237.750	10587.750	152	10283.250	10633.250
49	10193.125	10543.125	101	10238.625	10588.625	153	10284.125	10634.125
50	10194.000	10544.000	102	10239.500	10589.500	154	10285.000	10635.000
51	10194.875	10544.875	103	10240.375	10590.375	155	10285.875	10635.875
52	10195.750	10545.750	104	10241.250	10591.250	156	10286.750	10636.750
53	10196.625	10546.625	105	10242.125	10592.125	157	10287.625	10637.625
54	10197.500	10547.500	106	10243.000	10593.000	158	10288.500	10638.500
55	10198.375	10548.375	107	10243.875	10593.875	159	10289.375	10639.375
56	10199.250	10549.250	108	10244.750	10594.750	160	10290.250	10640.250
57	10200.125	10550.125	109	10245.625	10595.625	161	10291.125	10641.125
58	10201.000	10551.000	110	10246.500	10596.500	162	10292.000	10642.000
59	10201.875	10551.875	111	10247.375	10597.375	163	10292.875	10642.875

Table A-4: 26GHz ETSI A Frequency Band (Indexes 8 – 120)

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
8	24556.000	25564.000	46	24589.250	25597.250	84	24622.500	25630.500
9	24556.875	25564.875	47	24590.125	25598.125	85	24623.375	25631.375
10	24557.750	25565.750	48	24591.000	25599.000	86	24624.250	25632.250
11	24558.625	25566.625	49	24591.875	25599.875	87	24625.125	25633.125
12	24559.500	25567.500	50	24592.750	25600.750	88	24626.000	25634.000
13	24560.375	25568.375	51	24593.625	25601.625	89	24626.875	25634.875
14	24561.250	25569.250	52	24594.500	25602.500	90	24627.750	25635.750
15	24562.125	25570.125	53	24595.375	25603.375	91	24628.625	25636.625
16	24563.000	25571.000	54	24596.250	25604.250	92	24629.500	25637.500
17	24563.875	25571.875	55	24597.125	25605.125	93	24630.375	25638.375
18	24564.750	25572.750	56	24598.000	25606.000	94	24631.250	25639.250
19	24565.625	25573.625	57	24598.875	25606.875	95	24632.125	25640.125
20	24566.500	25574.500	58	24599.750	25607.750	96	24633.000	25641.000
21	24567.375	25575.375	59	24600.625	25608.625	97	24633.875	25641.875
22	24568.250	25576.250	60	24601.500	25609.500	98	24634.750	25642.750
23	24569.125	25577.125	61	24602.375	25610.375	99	24635.625	25643.625
24	24570.000	25578.000	62	24603.250	25611.250	100	24636.500	25644.500
25	24570.875	25578.875	63	24604.125	25612.125	101	24637.375	25645.375
26	24571.750	25579.750	64	24605.000	25613.000	102	24638.250	25646.250
27	24572.625	25580.625	65	24605.875	25613.875	103	24639.125	25647.125
28	24573.500	25581.500	66	24606.750	25614.750	104	24640.000	25648.000
29	24574.375	25582.375	67	24607.625	25615.625	105	24640.875	25648.875
30	24575.250	25583.250	68	24608.500	25616.500	106	24641.750	25649.750
31	24576.125	25584.125	69	24609.375	25617.375	107	24642.625	25650.625
32	24577.000	25585.000	70	24610.250	25618.250	108	24643.500	25651.500
33	24577.875	25585.875	71	24611.125	25619.125	109	24644.375	25652.375
34	24578.750	25586.750	72	24612.000	25620.000	110	24645.250	25653.250
35	24579.625	25587.625	73	24612.875	25620.875	111	24646.125	25654.125
36	24580.500	25588.500	74	24613.750	25621.750	112	24647.000	25655.000
37	24581.375	25589.375	75	24614.625	25622.625	113	24647.875	25655.875
38	24582.250	25590.250	76	24615.500	25623.500	114	24648.750	25656.750
39	24583.125	25591.125	77	24616.375	25624.375	115	24649.625	25657.625
40	24584.000	25592.000	78	24617.250	25625.250	116	24650.500	25658.500
41	24584.875	25592.875	79	24618.125	25626.125	117	24651.375	25659.375
42	24585.750	25593.750	80	24619.000	25627.000	118	24652.250	25660.250
43	24586.625	25594.625	81	24619.875	25627.875	119	24653.125	25661.125
44	24587.500	25595.500	82	24620.750	25628.750	120	24654.000	25662.000
45	24588.375	25596.375	83	24621.625	25629.625			

Table A-5: 26GHz ETSI B Frequency Band (Indexes 104 - 217)								
Index	**BS Tx**	**BS Rx**	**Index**	**BS Tx**	**BS Rx**	**Index**	**BS Tx**	**BS Rx**
	TS Rx	**TS Tx**		**TS Rx**	**TS Tx**		**TS Rx**	**TS Tx**
104	24640.000	25648.000	153	24682.875	25690.875	202	24725.750	25733.750
105	24640.875	25648.875	154	24683.750	25691.750	203	24726.625	25734.625
106	24641.750	25649.750	155	24684.625	25692.625	204	24727.500	25735.500
107	24642.625	25650.625	156	24685.500	25693.500	205	24728.375	25736.375
108	24643.500	25651.500	157	24686.375	25694.375	206	24729.250	25737.250
109	24644.375	25652.375	158	24687.250	25695.250	207	24730.125	25738.125
110	24645.250	25653.250	159	24688.125	25696.125	208	24731.000	25739.000
111	24646.125	25654.125	160	24689.000	25697.000	209	24731.875	25739.875
112	24647.000	25655.000	161	24689.875	25697.875	210	24732.750	25740.750
113	24647.875	25655.875	162	24690.750	25698.750	211	24733.625	25741.625
114	24648.750	25656.750	163	24691.625	25699.625	212	24734.500	25742.500
115	24649.625	25657.625	164	24692.500	25700.500	213	24735.375	25743.375
116	24650.500	25658.500	165	24693.375	25701.375	214	24736.250	25744.250
117	24651.375	25659.375	166	24694.250	25702.250	215	24737.125	25745.125
118	24652.250	25660.250	167	24695.125	25703.125	216	24738.000	25746.000
119	24653.125	25661.125	168	24696.000	25704.000	217	24738.875	25746.875
120	24654.000	25662.000	169	24696.875	25704.875	218	24739.750	25747.750
121	24654.875	25662.875	170	24697.750	25705.750	219	24740.625	25748.625
122	24655.750	25663.750	171	24698.625	25706.625	220	24741.500	25749.500
123	24656.625	25664.625	172	24699.500	25707.500	221	24742.375	25750.375
124	24657.500	25665.500	173	24700.375	25708.375	222	24743.250	25751.250
125	24658.375	25666.375	174	24701.250	25709.250	223	24744.125	25752.125
126	24659.250	25667.250	175	24702.125	25710.125	224	24745.000	25753.000
127	24660.125	25668.125	176	24703.000	25711.000	225	24745.875	25753.875
128	24661.000	25669.000	177	24703.875	25711.875	226	24746.750	25754.750
129	24661.875	25669.875	178	24704.750	25712.750	227	24747.625	25755.625
130	24662.750	25670.750	179	24705.625	25713.625	228	24748.500	25756.500
131	24663.625	25671.625	180	24706.500	25714.500	229	24749.375	25757.375
132	24664.500	25672.500	181	24707.375	25715.375	230	24750.250	25758.250
133	24665.375	25673.375	182	24708.250	25716.250	231	24751.125	25759.125
134	24666.250	25674.250	183	24709.125	25717.125	232	24752.000	25760.000
135	24667.125	25675.125	184	24710.000	25718.000	233	24752.875	25760.875
136	24668.000	25676.000	185	24710.875	25718.875	234	24753.750	25761.750
137	24668.875	25676.875	186	24711.750	25719.750	235	24754.625	25762.625
138	24669.750	25677.750	187	24712.625	25720.625	236	24755.500	25763.500
139	24670.625	25678.625	188	24713.500	25721.500	237	24756.375	25764.375
140	24671.500	25679.500	189	24714.375	25722.375	238	24757.250	25765.250
141	24672.375	25680.375	190	24715.250	25723.250	239	24758.125	25766.125
142	24673.250	25681.250	191	24716.125	25724.125	240	24759.000	25767.000

Table A-5: 26GHz ETSI B Frequency Band (Indexes 104 - 217)								
Index	BS Tx	BS Rx	Index	BS Tx	BS Rx	Index	BS Tx	BS Rx
	TS Rx	TS Tx		TS Rx	TS Tx		TS Rx	TS Tx
143	24674.125	25682.125	192	24717.000	25725.000	241	24759.875	25767.875
144	24675.000	25683.000	193	24717.875	25725.875	242	24760.750	25768.750
145	24675.875	25683.875	194	24718.750	25726.750	243	24761.625	25769.625
146	24676.750	25684.750	195	24719.625	25727.625	244	24762.500	25770.500
147	24677.625	25685.625	196	24720.500	25728.500	245	24763.375	25771.375
148	24678.500	25686.500	197	24721.375	25729.375	246	24764.250	25772.250
149	24679.375	25687.375	198	24722.250	25730.250	247	24765.125	25773.125
150	24680.250	25688.250	199	24723.125	25731.125	248	24766.000	25774.000
151	24681.125	25689.125	200	24724.000	25732.000			
152	24682.000	25690.000	201	24724.875	25732.875			

Table A-6: 26GHz ETSI C Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
264	24780.000	25788.000	302	24813.250	25821.250	340	24846.500	25854.500
265	24780.875	25788.875	303	24814.125	25822.125	341	24847.375	25855.375
266	24781.750	25789.750	304	24815.000	25823.000	342	24848.250	25856.250
267	24782.625	25790.625	305	24815.875	25823.875	343	24849.125	25857.125
268	24783.500	25791.500	306	24816.750	25824.750	344	24850.000	25858.000
269	24784.375	25792.375	307	24817.625	25825.625	345	24850.875	25858.875
270	24785.250	25793.250	308	24818.500	25826.500	346	24851.750	25859.750
271	24786.125	25794.125	309	24819.375	25827.375	347	24852.625	25860.625
272	24787.000	25795.000	310	24820.250	25828.250	348	24853.500	25861.500
273	24787.875	25795.875	311	24821.125	25829.125	349	24854.375	25862.375
274	24788.750	25796.750	312	24822.000	25830.000	350	24855.250	25863.250
275	24789.625	25797.625	313	24822.875	25830.875	351	24856.125	25864.125
276	24790.500	25798.500	314	24823.750	25831.750	352	24857.000	25865.000
277	24791.375	25799.375	315	24824.625	25832.625	353	24857.875	25865.875
278	24792.250	25800.250	316	24825.500	25833.500	354	24858.750	25866.750
279	24793.125	25801.125	317	24826.375	25834.375	355	24859.625	25867.625
280	24794.000	25802.000	318	24827.250	25835.250	356	24860.500	25868.500
281	24794.875	25802.875	319	24828.125	25836.125	357	24861.375	25869.375
282	24795.750	25803.750	320	24829.000	25837.000	358	24862.250	25870.250
283	24796.625	25804.625	321	24829.875	25837.875	359	24863.125	25871.125
284	24797.500	25805.500	322	24830.750	25838.750	360	24864.000	25872.000
285	24798.375	25806.375	323	24831.625	25839.625	361	24864.875	25872.875
286	24799.250	25807.250	324	24832.500	25840.500	362	24865.750	25873.750
287	24800.125	25808.125	325	24833.375	25841.375	363	24866.625	25874.625
288	24801.000	25809.000	326	24834.250	25842.250	364	24867.500	25875.500
289	24801.875	25809.875	327	24835.125	25843.125	365	24868.375	25876.375
290	24802.750	25810.750	328	24836.000	25844.000	366	24869.250	25877.250
291	24803.625	25811.625	329	24836.875	25844.875	367	24870.125	25878.125
292	24804.500	25812.500	330	24837.750	25845.750	368	24871.000	25879.000
293	24805.375	25813.375	331	24838.625	25846.625	369	24871.875	25879.875
294	24806.250	25814.250	332	24839.500	25847.500	370	24872.750	25880.750
295	24807.125	25815.125	333	24840.375	25848.375	371	24873.625	25881.625
296	24808.000	25816.000	334	24841.250	25849.250	372	24874.500	25882.500
297	24808.875	25816.875	335	24842.125	25850.125	373	24875.375	25883.375
298	24809.750	25817.750	336	24843.000	25851.000	374	24876.250	25884.250
299	24810.625	25818.625	337	24843.875	25851.875	375	24877.125	25885.125
300	24811.500	25819.500	338	24844.750	25852.750	376	24878.000	25886.000
301	24812.375	25820.375	339	24845.625	25853.625			

Table A-7: 26GHz ETSI D Frequency Band								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
392	24892.000	25900.000	430	24925.250	25933.250	468	24958.500	25966.500
393	24892.875	25900.875	431	24926.125	25934.125	469	24959.375	25967.375
394	24893.750	25901.750	432	24927.000	25935.000	470	24960.250	25968.250
395	24894.625	25902.625	433	24927.875	25935.875	471	24961.125	25969.125
396	24895.500	25903.500	434	24928.750	25936.750	472	24962.000	25970.000
397	24896.375	25904.375	435	24929.625	25937.625	473	24962.875	25970.875
398	24897.250	25905.250	436	24930.500	25938.500	474	24963.750	25971.750
399	24898.125	25906.125	437	24931.375	25939.375	475	24964.625	25972.625
400	24899.000	25907.000	438	24932.250	25940.250	476	24965.500	25973.500
401	24899.875	25907.875	439	24933.125	25941.125	477	24966.375	25974.375
402	24900.750	25908.750	440	24934.000	25942.000	478	24967.250	25975.250
403	24901.625	25909.625	441	24934.875	25942.875	479	24968.125	25976.125
404	24902.500	25910.500	442	24935.750	25943.750	480	24969.000	25977.000
405	24903.375	25911.375	443	24936.625	25944.625	481	24969.875	25977.875
406	24904.250	25912.250	444	24937.500	25945.500	482	24970.750	25978.750
407	24905.125	25913.125	445	24938.375	25946.375	483	24971.625	25979.625
408	24906.000	25914.000	446	24939.250	25947.250	484	24972.500	25980.500
409	24906.875	25914.875	447	24940.125	25948.125	485	24973.375	25981.375
410	24907.750	25915.750	448	24941.000	25949.000	486	24974.250	25982.250
411	24908.625	25916.625	449	24941.875	25949.875	487	24975.125	25983.125
412	24909.500	25917.500	450	24942.750	25950.750	488	24976.000	25984.000
413	24910.375	25918.375	451	24943.625	25951.625	489	24976.875	25984.875
414	24911.250	25919.250	452	24944.500	25952.500	490	24977.750	25985.750
415	24912.125	25920.125	453	24945.375	25953.375	491	24978.625	25986.625
416	24913.000	25921.000	454	24946.250	25954.250	492	24979.500	25987.500
417	24913.875	25921.875	455	24947.125	25955.125	493	24980.375	25988.375
418	24914.750	25922.750	456	24948.000	25956.000	494	24981.250	25989.250
419	24915.625	25923.625	457	24948.875	25956.875	495	24982.125	25990.125
420	24916.500	25924.500	458	24949.750	25957.750	496	24983.000	25991.000
421	24917.375	25925.375	459	24950.625	25958.625	497	24983.875	25991.875
422	24918.250	25926.250	460	24951.500	25959.500	498	24984.750	25992.750
423	24919.125	25927.125	461	24952.375	25960.375	499	24985.625	25993.625
424	24920.000	25928.000	462	24953.250	25961.250	500	24986.500	25994.500
425	24920.875	25928.875	463	24954.125	25962.125	501	24987.375	25995.375
426	24921.750	25929.750	464	24955.000	25963.000	502	24988.250	25996.250
427	24922.625	25930.625	465	24955.875	25963.875	503	24989.125	25997.125
428	24923.500	25931.500	466	24956.750	25964.750	504	24990.000	25998.000
429	24924.375	25932.375	467	24957.625	25965.625			

Table A-8: 26GHz ETSI E Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
488	24976.000	25984.000	537	25018.875	26026.875	586	25061.750	26069.750
489	24976.875	25984.875	538	25019.750	26027.750	587	25062.625	26070.625
490	24977.750	25985.750	539	25020.625	26028.625	588	25063.500	26071.500
491	24978.625	25986.625	540	25021.500	26029.500	589	25064.375	26072.375
492	24979.500	25987.500	541	25022.375	26030.375	590	25065.250	26073.250
493	24980.375	25988.375	542	25023.250	26031.250	591	25066.125	26074.125
494	24981.250	25989.250	543	25024.125	26032.125	592	25067.000	26075.000
495	24982.125	25990.125	544	25025.000	26033.000	593	25067.875	26075.875
496	24983.000	25991.000	545	25025.875	26033.875	594	25068.750	26076.750
497	24983.875	25991.875	546	25026.750	26034.750	595	25069.625	26077.625
498	24984.750	25992.750	547	25027.625	26035.625	596	25070.500	26078.500
499	24985.625	25993.625	548	25028.500	26036.500	597	25071.375	26079.375
500	24986.500	25994.500	549	25029.375	26037.375	598	25072.250	26080.250
501	24987.375	25995.375	550	25030.250	26038.250	599	25073.125	26081.125
502	24988.250	25996.250	551	25031.125	26039.125	600	25074.000	26082.000
503	24989.125	25997.125	552	25032.000	26040.000	601	25074.875	26082.875
504	24990.000	25998.000	553	25032.875	26040.875	602	25075.750	26083.750
505	24990.875	25998.875	554	25033.750	26041.750	603	25076.625	26084.625
506	24991.750	25999.750	555	25034.625	26042.625	604	25077.500	26085.500
507	24992.625	26000.625	556	25035.500	26043.500	605	25078.375	26086.375
508	24993.500	26001.500	557	25036.375	26044.375	606	25079.250	26087.250
509	24994.375	26002.375	558	25037.250	26045.250	607	25080.125	26088.125
510	24995.250	26003.250	559	25038.125	26046.125	608	25081.000	26089.000
511	24996.125	26004.125	560	25039.000	26047.000	609	25081.875	26089.875
512	24997.000	26005.000	561	25039.875	26047.875	610	25082.750	26090.750
513	24997.875	26005.875	562	25040.750	26048.750	611	25083.625	26091.625
514	24998.750	26006.750	563	25041.625	26049.625	612	25084.500	26092.500
515	24999.625	26007.625	564	25042.500	26050.500	613	25085.375	26093.375
516	25000.500	26008.500	565	25043.375	26051.375	614	25086.250	26094.250
517	25001.375	26009.375	566	25044.250	26052.250	615	25087.125	26095.125
518	25002.250	26010.250	567	25045.125	26053.125	616	25088.000	26096.000
519	25003.125	26011.125	568	25046.000	26054.000	617	25088.875	26096.875
520	25004.000	26012.000	569	25046.875	26054.875	618	25089.750	26097.750
521	25004.875	26012.875	570	25047.750	26055.750	619	25090.625	26098.625
522	25005.750	26013.750	571	25048.625	26056.625	620	25091.500	26099.500
523	25006.625	26014.625	572	25049.500	26057.500	621	25092.375	26100.375
524	25007.500	26015.500	573	25050.375	26058.375	622	25093.250	26101.250
525	25008.375	26016.375	574	25051.250	26059.250	623	25094.125	26102.125

Table A-8: 26GHz ETSI E Frequency Band								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
526	25009.250	26017.250	575	25052.125	26060.125	624	25095.000	26103.000
527	25010.125	26018.125	576	25053.000	26061.000	625	25095.875	26103.875
528	25011.000	26019.000	577	25053.875	26061.875	626	25096.750	26104.750
529	25011.875	26019.875	578	25054.750	26062.750	627	25097.625	26105.625
530	25012.750	26020.750	579	25055.625	26063.625	628	25098.500	26106.500
531	25013.625	26021.625	580	25056.500	26064.500	629	25099.375	26107.375
532	25014.500	26022.500	581	25057.375	26065.375	630	25100.250	26108.250
533	25015.375	26023.375	582	25058.250	26066.250	631	25101.125	26109.125
534	25016.250	26024.250	583	25059.125	26067.125	632	25102.000	26110.000
535	25017.125	26025.125	584	25060.000	26068.000			
536	25018.000	26026.000	585	25060.875	26068.875			

Table A-9: 26GHz ETSI F Frequency Band (Indexes 648 - 760)

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
648	25116.000	26124.000	686	25149.250	26157.250	724	25182.500	26190.500
649	25116.875	26124.875	687	25150.125	26158.125	725	25183.375	26191.375
650	25117.750	26125.750	688	25151.000	26159.000	726	25184.250	26192.250
651	25118.625	26126.625	689	25151.875	26159.875	727	25185.125	26193.125
652	25119.500	26127.500	690	25152.750	26160.750	728	25186.000	26194.000
653	25120.375	26128.375	691	25153.625	26161.625	729	25186.875	26194.875
654	25121.250	26129.250	692	25154.500	26162.500	730	25187.750	26195.750
655	25122.125	26130.125	693	25155.375	26163.375	731	25188.625	26196.625
656	25123.000	26131.000	694	25156.250	26164.250	732	25189.500	26197.500
657	25123.875	26131.875	695	25157.125	26165.125	733	25190.375	26198.375
658	25124.750	26132.750	696	25158.000	26166.000	734	25191.250	26199.250
659	25125.625	26133.625	697	25158.875	26166.875	735	25192.125	26200.125
660	25126.500	26134.500	698	25159.750	26167.750	736	25193.000	26201.000
661	25127.375	26135.375	699	25160.625	26168.625	737	25193.875	26201.875
662	25128.250	26136.250	700	25161.500	26169.500	738	25194.750	26202.750
663	25129.125	26137.125	701	25162.375	26170.375	739	25195.625	26203.625
664	25130.000	26138.000	702	25163.250	26171.250	740	25196.500	26204.500
665	25130.875	26138.875	703	25164.125	26172.125	741	25197.375	26205.375
666	25131.750	26139.750	704	25165.000	26173.000	742	25198.250	26206.250
667	25132.625	26140.625	705	25165.875	26173.875	743	25199.125	26207.125
668	25133.500	26141.500	706	25166.750	26174.750	744	25200.000	26208.000
669	25134.375	26142.375	707	25167.625	26175.625	745	25200.875	26208.875
670	25135.250	26143.250	708	25168.500	26176.500	746	25201.750	26209.750
671	25136.125	26144.125	709	25169.375	26177.375	747	25202.625	26210.625
672	25137.000	26145.000	710	25170.250	26178.250	748	25203.500	26211.500
673	25137.875	26145.875	711	25171.125	26179.125	749	25204.375	26212.375
674	25138.750	26146.750	712	25172.000	26180.000	750	25205.250	26213.250
675	25139.625	26147.625	713	25172.875	26180.875	751	25206.125	26214.125
676	25140.500	26148.500	714	25173.750	26181.750	752	25207.000	26215.000
677	25141.375	26149.375	715	25174.625	26182.625	753	25207.875	26215.875
678	25142.250	26150.250	716	25175.500	26183.500	754	25208.750	26216.750
679	25143.125	26151.125	717	25176.375	26184.375	755	25209.625	26217.625
680	25144.000	26152.000	718	25177.250	26185.250	756	25210.500	26218.500
681	25144.875	26152.875	719	25178.125	26186.125	757	25211.375	26219.375
682	25145.750	26153.750	720	25179.000	26187.000	758	25212.250	26220.250
683	25146.625	26154.625	721	25179.875	26187.875	759	25213.125	26221.125
684	25147.500	26155.500	722	25180.750	26188.750	760	25214.000	26222.000
685	25148.375	26156.375	723	25181.625	26189.625			

Table A-10: 26GHz ETSI G Frequency Band (Indexes 776 - 888)								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
776	25228.000	26236.000	814	25261.250	26269.250	852	25294.500	26302.500
777	25228.875	26236.875	815	25262.125	26270.125	853	25295.375	26303.375
778	25229.750	26237.750	816	25263.000	26271.000	854	25296.250	26304.250
779	25230.625	26238.625	817	25263.875	26271.875	855	25297.125	26305.125
780	25231.500	26239.500	818	25264.750	26272.750	856	25298.000	26306.000
781	25232.375	26240.375	819	25265.625	26273.625	857	25298.875	26306.875
782	25233.250	26241.250	820	25266.500	26274.500	858	25299.750	26307.750
783	25234.125	26242.125	821	25267.375	26275.375	859	25300.625	26308.625
784	25235.000	26243.000	822	25268.250	26276.250	860	25301.500	26309.500
785	25235.875	26243.875	823	25269.125	26277.125	861	25302.375	26310.375
786	25236.750	26244.750	824	25270.000	26278.000	862	25303.250	26311.250
787	25237.625	26245.625	825	25270.875	26278.875	863	25304.125	26312.125
788	25238.500	26246.500	826	25271.750	26279.750	864	25305.000	26313.000
789	25239.375	26247.375	827	25272.625	26280.625	865	25305.875	26313.875
790	25240.250	26248.250	828	25273.500	26281.500	866	25306.750	26314.750
791	25241.125	26249.125	829	25274.375	26282.375	867	25307.625	26315.625
792	25242.000	26250.000	830	25275.250	26283.250	868	25308.500	26316.500
793	25242.875	26250.875	831	25276.125	26284.125	869	25309.375	26317.375
794	25243.750	26251.750	832	25277.000	26285.000	870	25310.250	26318.250
795	25244.625	26252.625	833	25277.875	26285.875	871	25311.125	26319.125
796	25245.500	26253.500	834	25278.750	26286.750	872	25312.000	26320.000
797	25246.375	26254.375	835	25279.625	26287.625	873	25312.875	26320.875
798	25247.250	26255.250	836	25280.500	26288.500	874	25313.750	26321.750
799	25248.125	26256.125	837	25281.375	26289.375	875	25314.625	26322.625
800	25249.000	26257.000	838	25282.250	26290.250	876	25315.500	26323.500
801	25249.875	26257.875	839	25283.125	26291.125	877	25316.375	26324.375
802	25250.750	26258.750	840	25284.000	26292.000	878	25317.250	26325.250
803	25251.625	26259.625	841	25284.875	26292.875	879	25318.125	26326.125
804	25252.500	26260.500	842	25285.750	26293.750	880	25319.000	26327.000
805	25253.375	26261.375	843	25286.625	26294.625	881	25319.875	26327.875
806	25254.250	26262.250	844	25287.500	26295.500	882	25320.750	26328.750
807	25255.125	26263.125	845	25288.375	26296.375	883	25321.625	26329.625
808	25256.000	26264.000	846	25289.250	26297.250	884	25322.500	26330.500
809	25256.875	26264.875	847	25290.125	26298.125	885	25323.375	26331.375
810	25257.750	26265.750	848	25291.000	26299.000	886	25324.250	26332.250
811	25258.625	26266.625	849	25291.875	26299.875	887	25325.125	26333.125
812	25259.500	26267.500	850	25292.750	26300.750	888	25326.000	26334.000
813	25260.375	26268.375	851	25293.625	26301.625			

Table A-11: 26GHz ETSI H Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
904	25340.000	26348.000	942	25373.250	26381.250	980	25406.500	26414.500
905	25340.875	26348.875	943	25374.125	26382.125	981	25407.375	26415.375
906	25341.750	26349.750	944	25375.000	26383.000	982	25408.250	26416.250
907	25342.625	26350.625	945	25375.875	26383.875	983	25409.125	26417.125
908	25343.500	26351.500	946	25376.750	26384.750	984	25410.000	26418.000
909	25344.375	26352.375	947	25377.625	26385.625	985	25410.875	26418.875
910	25345.250	26353.250	948	25378.500	26386.500	986	25411.750	26419.750
911	25346.125	26354.125	949	25379.375	26387.375	987	25412.625	26420.625
912	25347.000	26355.000	950	25380.250	26388.250	988	25413.500	26421.500
913	25347.875	26355.875	951	25381.125	26389.125	989	25414.375	26422.375
914	25348.750	26356.750	952	25382.000	26390.000	990	25415.250	26423.250
915	25349.625	26357.625	953	25382.875	26390.875	991	25416.125	26424.125
916	25350.500	26358.500	954	25383.750	26391.750	992	25417.000	26425.000
917	25351.375	26359.375	955	25384.625	26392.625	993	25417.875	26425.875
918	25352.250	26360.250	956	25385.500	26393.500	994	25418.750	26426.750
919	25353.125	26361.125	957	25386.375	26394.375	995	25419.625	26427.625
920	25354.000	26362.000	958	25387.250	26395.250	996	25420.500	26428.500
921	25354.875	26362.875	959	25388.125	26396.125	997	25421.375	26429.375
922	25355.750	26363.750	960	25389.000	26397.000	998	25422.250	26430.250
923	25356.625	26364.625	961	25389.875	26397.875	999	25423.125	26431.125
924	25357.500	26365.500	962	25390.750	26398.750	1000	25424.000	26432.000
925	25358.375	26366.375	963	25391.625	26399.625	1001	25424.875	26432.875
926	25359.250	26367.250	964	25392.500	26400.500	1002	25425.750	26433.750
927	25360.125	26368.125	965	25393.375	26401.375	1003	25426.625	26434.625
928	25361.000	26369.000	966	25394.250	26402.250	1004	25427.500	26435.500
929	25361.875	26369.875	967	25395.125	26403.125	1005	25428.375	26436.375
930	25362.750	26370.750	968	25396.000	26404.000	1006	25429.250	26437.250
931	25363.625	26371.625	969	25396.875	26404.875	1007	25430.125	26438.125
932	25364.500	26372.500	970	25397.750	26405.750	1008	25431.000	26439.000
933	25365.375	26373.375	971	25398.625	26406.625	1009	25431.875	26439.875
934	25366.250	26374.250	972	25399.500	26407.500	1010	25432.750	26440.750
935	25367.125	26375.125	973	25400.375	26408.375	1011	25433.625	26441.625
936	25368.000	26376.000	974	25401.250	26409.250	1012	25434.500	26442.500
937	25368.875	26376.875	975	25402.125	26410.125	1013	25435.375	26443.375
938	25369.750	26377.750	976	25403.000	26411.000	1014	25436.250	26444.250
939	25370.625	26378.625	977	25403.875	26411.875	1015	25437.125	26445.125
940	25371.500	26379.500	978	25404.750	26412.750	1016	25438.000	26446.000
941	25372.375	26380.375	979	25405.625	26413.625			

Table A-12: 26GHz CHINA A0 Frequency Band								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
72	24514.000	25764.000	110	24547.250	25797.250	148	24580.500	25830.500
73	24514.875	25764.875	111	24548.125	25798.125	149	24581.375	25831.375
74	24515.750	25765.750	112	24549.000	25799.000	150	24582.250	25832.250
75	24516.625	25766.625	113	24549.875	25799.875	151	24583.125	25833.125
76	24517.500	25767.500	114	24550.750	25800.750	152	24584.000	25834.000
77	24518.375	25768.375	115	24551.625	25801.625	153	24584.875	25834.875
78	24519.250	25769.250	116	24552.500	25802.500	154	24585.750	25835.750
79	24520.125	25770.125	117	24553.375	25803.375	155	24586.625	25836.625
80	24521.000	25771.000	118	24554.250	25804.250	156	24587.500	25837.500
81	24521.875	25771.875	119	24555.125	25805.125	157	24588.375	25838.375
82	24522.750	25772.750	120	24556.000	25806.000	158	24589.250	25839.250
83	24523.625	25773.625	121	24556.875	25806.875	159	24590.125	25840.125
84	24524.500	25774.500	122	24557.750	25807.750	160	24591.000	25841.000
85	24525.375	25775.375	123	24558.625	25808.625	161	24591.875	25841.875
86	24526.250	25776.250	124	24559.500	25809.500	162	24592.750	25842.750
87	24527.125	25777.125	125	24560.375	25810.375	163	24593.625	25843.625
88	24528.000	25778.000	126	24561.250	25811.250	164	24594.500	25844.500
89	24528.875	25778.875	127	24562.125	25812.125	165	24595.375	25845.375
90	24529.750	25779.750	128	24563.000	25813.000	166	24596.250	25846.250
91	24530.625	25780.625	129	24563.875	25813.875	167	24597.125	25847.125
92	24531.500	25781.500	130	24564.750	25814.750	168	24598.000	25848.000
93	24532.375	25782.375	131	24565.625	25815.625	169	24598.875	25848.875
94	24533.250	25783.250	132	24566.500	25816.500	170	24599.750	25849.750
95	24534.125	25784.125	133	24567.375	25817.375	171	24600.625	25850.625
96	24535.000	25785.000	134	24568.250	25818.250	172	24601.500	25851.500
97	24535.875	25785.875	135	24569.125	25819.125	173	24602.375	25852.375
98	24536.750	25786.750	136	24570.000	25820.000	174	24603.250	25853.250
99	24537.625	25787.625	137	24570.875	25820.875	175	24604.125	25854.125
100	24538.500	25788.500	138	24571.750	25821.750	176	24605.000	25855.000
101	24539.375	25789.375	139	24572.625	25822.625	177	24605.875	25855.875
102	24540.250	25790.250	140	24573.500	25823.500	178	24606.750	25856.750
103	24541.125	25791.125	141	24574.375	25824.375	179	24607.625	25857.625
104	24542.000	25792.000	142	24575.250	25825.250	180	24608.500	25858.500
105	24542.875	25792.875	143	24576.125	25826.125	181	24609.375	25859.375
106	24543.750	25793.750	144	24577.000	25827.000	182	24610.250	25860.250
107	24544.625	25794.625	145	24577.875	25827.875	183	24611.125	25861.125
108	24545.500	25795.500	146	24578.750	25828.750	184	24612.000	25862.000
109	24546.375	25796.375	147	24579.625	25829.625			

Table A-13: 26GHz CHINA A1 Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
200	24626.000	25876.000	238	24659.250	25909.250	276	24692.500	25942.500
201	24626.875	25876.875	239	24660.125	25910.125	277	24693.375	25943.375
202	24627.750	25877.750	240	24661.000	25911.000	278	24694.250	25944.250
203	24628.625	25878.625	241	24661.875	25911.875	279	24695.125	25945.125
204	24629.500	25879.500	242	24662.750	25912.750	280	24696.000	25946.000
205	24630.375	25880.375	243	24663.625	25913.625	281	24696.875	25946.875
206	24631.250	25881.250	244	24664.500	25914.500	282	24697.750	25947.750
207	24632.125	25882.125	245	24665.375	25915.375	283	24698.625	25948.625
208	24633.000	25883.000	246	24666.250	25916.250	284	24699.500	25949.500
209	24633.875	25883.875	247	24667.125	25917.125	285	24700.375	25950.375
210	24634.750	25884.750	248	24668.000	25918.000	286	24701.250	25951.250
211	24635.625	25885.625	249	24668.875	25918.875	287	24702.125	25952.125
212	24636.500	25886.500	250	24669.750	25919.750	288	24703.000	25953.000
213	24637.375	25887.375	251	24670.625	25920.625	289	24703.875	25953.875
214	24638.250	25888.250	252	24671.500	25921.500	290	24704.750	25954.750
215	24639.125	25889.125	253	24672.375	25922.375	291	24705.625	25955.625
216	24640.000	25890.000	254	24673.250	25923.250	292	24706.500	25956.500
217	24640.875	25890.875	255	24674.125	25924.125	293	24707.375	25957.375
218	24641.750	25891.750	256	24675.000	25925.000	294	24708.250	25958.250
219	24642.625	25892.625	257	24675.875	25925.875	295	24709.125	25959.125
220	24643.500	25893.500	258	24676.750	25926.750	296	24710.000	25960.000
221	24644.375	25894.375	259	24677.625	25927.625	297	24710.875	25960.875
222	24645.250	25895.250	260	24678.500	25928.500	298	24711.750	25961.750
223	24646.125	25896.125	261	24679.375	25929.375	299	24712.625	25962.625
224	24647.000	25897.000	262	24680.250	25930.250	300	24713.500	25963.500
225	24647.875	25897.875	263	24681.125	25931.125	301	24714.375	25964.375
226	24648.750	25898.750	264	24682.000	25932.000	302	24715.250	25965.250
227	24649.625	25899.625	265	24682.875	25932.875	303	24716.125	25966.125
228	24650.500	25900.500	266	24683.750	25933.750	304	24717.000	25967.000
229	24651.375	25901.375	267	24684.625	25934.625	305	24717.875	25967.875
230	24652.250	25902.250	268	24685.500	25935.500	306	24718.750	25968.750
231	24653.125	25903.125	269	24686.375	25936.375	307	24719.625	25969.625
232	24654.000	25904.000	270	24687.250	25937.250	308	24720.500	25970.500
233	24654.875	25904.875	271	24688.125	25938.125	309	24721.375	25971.375
234	24655.750	25905.750	272	24689.000	25939.000	310	24722.250	25972.250
235	24656.625	25906.625	273	24689.875	25939.875	311	24723.125	25973.125
236	24657.500	25907.500	274	24690.750	25940.750	312	24724.000	25974.000
237	24658.375	25908.375	275	24691.625	25941.625			

Table A-14: 26GHz CHINA B1 Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
328	24738.000	25988.000	366	24771.250	26021.250	404	24804.500	26054.500
329	24738.875	25988.875	367	24772.125	26022.125	405	24805.375	26055.375
330	24739.750	25989.750	368	24773.000	26023.000	406	24806.250	26056.250
331	24740.625	25990.625	369	24773.875	26023.875	407	24807.125	26057.125
332	24741.500	25991.500	370	24774.750	26024.750	408	24808.000	26058.000
333	24742.375	25992.375	371	24775.625	26025.625	409	24808.875	26058.875
334	24743.250	25993.250	372	24776.500	26026.500	410	24809.750	26059.750
335	24744.125	25994.125	373	24777.375	26027.375	411	24810.625	26060.625
336	24745.000	25995.000	374	24778.250	26028.250	412	24811.500	26061.500
337	24745.875	25995.875	375	24779.125	26029.125	413	24812.375	26062.375
338	24746.750	25996.750	376	24780.000	26030.000	414	24813.250	26063.250
339	24747.625	25997.625	377	24780.875	26030.875	415	24814.125	26064.125
340	24748.500	25998.500	378	24781.750	26031.750	416	24815.000	26065.000
341	24749.375	25999.375	379	24782.625	26032.625	417	24815.875	26065.875
342	24750.250	26000.250	380	24783.500	26033.500	418	24816.750	26066.750
343	24751.125	26001.125	381	24784.375	26034.375	419	24817.625	26067.625
344	24752.000	26002.000	382	24785.250	26035.250	420	24818.500	26068.500
345	24752.875	26002.875	383	24786.125	26036.125	421	24819.375	26069.375
346	24753.750	26003.750	384	24787.000	26037.000	422	24820.250	26070.250
347	24754.625	26004.625	385	24787.875	26037.875	423	24821.125	26071.125
348	24755.500	26005.500	386	24788.750	26038.750	424	24822.000	26072.000
349	24756.375	26006.375	387	24789.625	26039.625	425	24822.875	26072.875
350	24757.250	26007.250	388	24790.500	26040.500	426	24823.750	26073.750
351	24758.125	26008.125	389	24791.375	26041.375	427	24824.625	26074.625
352	24759.000	26009.000	390	24792.250	26042.250	428	24825.500	26075.500
353	24759.875	26009.875	391	24793.125	26043.125	429	24826.375	26076.375
354	24760.750	26010.750	392	24794.000	26044.000	430	24827.250	26077.250
355	24761.625	26011.625	393	24794.875	26044.875	431	24828.125	26078.125
356	24762.500	26012.500	394	24795.750	26045.750	432	24829.000	26079.000
357	24763.375	26013.375	395	24796.625	26046.625	433	24829.875	26079.875
358	24764.250	26014.250	396	24797.500	26047.500	434	24830.750	26080.750
359	24765.125	26015.125	397	24798.375	26048.375	435	24831.625	26081.625
360	24766.000	26016.000	398	24799.250	26049.250	436	24832.500	26082.500
361	24766.875	26016.875	399	24800.125	26050.125	437	24833.375	26083.375
362	24767.750	26017.750	400	24801.000	26051.000	438	24834.250	26084.250
363	24768.625	26018.625	401	24801.875	26051.875	439	24835.125	26085.125
364	24769.500	26019.500	402	24802.750	26052.750	440	24836.000	26086.000
365	24770.375	26020.375	403	24803.625	26053.625			

Table A-15: 26GHz CHINA A2 Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
456	24850.000	26100.000	494	24883.250	26133.250	532	24916.500	26166.500
457	24850.875	26100.875	495	24884.125	26134.125	533	24917.375	26167.375
458	24851.750	26101.750	496	24885.000	26135.000	534	24918.250	26168.250
459	24852.625	26102.625	497	24885.875	26135.875	535	24919.125	26169.125
460	24853.500	26103.500	498	24886.750	26136.750	536	24920.000	26170.000
461	24854.375	26104.375	499	24887.625	26137.625	537	24920.875	26170.875
462	24855.250	26105.250	500	24888.500	26138.500	538	24921.750	26171.750
463	24856.125	26106.125	501	24889.375	26139.375	539	24922.625	26172.625
464	24857.000	26107.000	502	24890.250	26140.250	540	24923.500	26173.500
465	24857.875	26107.875	503	24891.125	26141.125	541	24924.375	26174.375
466	24858.750	26108.750	504	24892.000	26142.000	542	24925.250	26175.250
467	24859.625	26109.625	505	24892.875	26142.875	543	24926.125	26176.125
468	24860.500	26110.500	506	24893.750	26143.750	544	24927.000	26177.000
469	24861.375	26111.375	507	24894.625	26144.625	545	24927.875	26177.875
470	24862.250	26112.250	508	24895.500	26145.500	546	24928.750	26178.750
471	24863.125	26113.125	509	24896.375	26146.375	547	24929.625	26179.625
472	24864.000	26114.000	510	24897.250	26147.250	548	24930.500	26180.500
473	24864.875	26114.875	511	24898.125	26148.125	549	24931.375	26181.375
474	24865.750	26115.750	512	24899.000	26149.000	550	24932.250	26182.250
475	24866.625	26116.625	513	24899.875	26149.875	551	24933.125	26183.125
476	24867.500	26117.500	514	24900.750	26150.750	552	24934.000	26184.000
477	24868.375	26118.375	515	24901.625	26151.625	553	24934.875	26184.875
478	24869.250	26119.250	516	24902.500	26152.500	554	24935.750	26185.750
479	24870.125	26120.125	517	24903.375	26153.375	555	24936.625	26186.625
480	24871.000	26121.000	518	24904.250	26154.250	556	24937.500	26187.500
481	24871.875	26121.875	519	24905.125	26155.125	557	24938.375	26188.375
482	24872.750	26122.750	520	24906.000	26156.000	558	24939.250	26189.250
483	24873.625	26123.625	521	24906.875	26156.875	559	24940.125	26190.125
484	24874.500	26124.500	522	24907.750	26157.750	560	24941.000	26191.000
485	24875.375	26125.375	523	24908.625	26158.625	561	24941.875	26191.875
486	24876.250	26126.250	524	24909.500	26159.500	562	24942.750	26192.750
487	24877.125	26127.125	525	24910.375	26160.375	563	24943.625	26193.625
488	24878.000	26128.000	526	24911.250	26161.250	564	24944.500	26194.500
489	24878.875	26128.875	527	24912.125	26162.125	565	24945.375	26195.375
490	24879.750	26129.750	528	24913.000	26163.000	566	24946.250	26196.250
491	24880.625	26130.625	529	24913.875	26163.875	567	24947.125	26197.125
492	24881.500	26131.500	530	24914.750	26164.750	568	24948.000	26198.000
493	24882.375	26132.375	531	24915.625	26165.625			

Table A-16: 26GHz CHINA A3 Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
584	24962.000	26212.000	622	24995.250	26245.250	660	25028.500	26278.500
585	24962.875	26212.875	623	24996.125	26246.125	661	25029.375	26279.375
586	24963.750	26213.750	624	24997.000	26247.000	662	25030.250	26280.250
587	24964.625	26214.625	625	24997.875	26247.875	663	25031.125	26281.125
588	24965.500	26215.500	626	24998.750	26248.750	664	25032.000	26282.000
589	24966.375	26216.375	627	24999.625	26249.625	665	25032.875	26282.875
590	24967.250	26217.250	628	25000.500	26250.500	666	25033.750	26283.750
591	24968.125	26218.125	629	25001.375	26251.375	667	25034.625	26284.625
592	24969.000	26219.000	630	25002.250	26252.250	668	25035.500	26285.500
593	24969.875	26219.875	631	25003.125	26253.125	669	25036.375	26286.375
594	24970.750	26220.750	632	25004.000	26254.000	670	25037.250	26287.250
595	24971.625	26221.625	633	25004.875	26254.875	671	25038.125	26288.125
596	24972.500	26222.500	634	25005.750	26255.750	672	25039.000	26289.000
597	24973.375	26223.375	635	25006.625	26256.625	673	25039.875	26289.875
598	24974.250	26224.250	636	25007.500	26257.500	674	25040.750	26290.750
599	24975.125	26225.125	637	25008.375	26258.375	675	25041.625	26291.625
600	24976.000	26226.000	638	25009.250	26259.250	676	25042.500	26292.500
601	24976.875	26226.875	639	25010.125	26260.125	677	25043.375	26293.375
602	24977.750	26227.750	640	25011.000	26261.000	678	25044.250	26294.250
603	24978.625	26228.625	641	25011.875	26261.875	679	25045.125	26295.125
604	24979.500	26229.500	642	25012.750	26262.750	680	25046.000	26296.000
605	24980.375	26230.375	643	25013.625	26263.625	681	25046.875	26296.875
606	24981.250	26231.250	644	25014.500	26264.500	682	25047.750	26297.750
607	24982.125	26232.125	645	25015.375	26265.375	683	25048.625	26298.625
608	24983.000	26233.000	646	25016.250	26266.250	684	25049.500	26299.500
609	24983.875	26233.875	647	25017.125	26267.125	685	25050.375	26300.375
610	24984.750	26234.750	648	25018.000	26268.000	686	25051.250	26301.250
611	24985.625	26235.625	649	25018.875	26268.875	687	25052.125	26302.125
612	24986.500	26236.500	650	25019.750	26269.750	688	25053.000	26303.000
613	24987.375	26237.375	651	25020.625	26270.625	689	25053.875	26303.875
614	24988.250	26238.250	652	25021.500	26271.500	690	25054.750	26304.750
615	24989.125	26239.125	653	25022.375	26272.375	691	25055.625	26305.625
616	24990.000	26240.000	654	25023.250	26273.250	692	25056.500	26306.500
617	24990.875	26240.875	655	25024.125	26274.125	693	25057.375	26307.375
618	24991.750	26241.750	656	25025.000	26275.000	694	25058.250	26308.250
619	24992.625	26242.625	657	25025.875	26275.875	695	25059.125	26309.125
620	24993.500	26243.500	658	25026.750	26276.750	696	25060.000	26310.000
621	24994.375	26244.375	659	25027.625	26277.625			

Table A-17: 26GHz CHINA B2 Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
712	25074.000	26324.000	750	25107.250	26357.250	788	25140.500	26390.500
713	25074.875	26324.875	751	25108.125	26358.125	789	25141.375	26391.375
714	25075.750	26325.750	752	25109.000	26359.000	790	25142.250	26392.250
715	25076.625	26326.625	753	25109.875	26359.875	791	25143.125	26393.125
716	25077.500	26327.500	754	25110.750	26360.750	792	25144.000	26394.000
717	25078.375	26328.375	755	25111.625	26361.625	793	25144.875	26394.875
718	25079.250	26329.250	756	25112.500	26362.500	794	25145.750	26395.750
719	25080.125	26330.125	757	25113.375	26363.375	795	25146.625	26396.625
720	25081.000	26331.000	758	25114.250	26364.250	796	25147.500	26397.500
721	25081.875	26331.875	759	25115.125	26365.125	797	25148.375	26398.375
722	25082.750	26332.750	760	25116.000	26366.000	798	25149.250	26399.250
723	25083.625	26333.625	761	25116.875	26366.875	799	25150.125	26400.125
724	25084.500	26334.500	762	25117.750	26367.750	800	25151.000	26401.000
725	25085.375	26335.375	763	25118.625	26368.625	801	25151.875	26401.875
726	25086.250	26336.250	764	25119.500	26369.500	802	25152.750	26402.750
727	25087.125	26337.125	765	25120.375	26370.375	803	25153.625	26403.625
728	25088.000	26338.000	766	25121.250	26371.250	804	25154.500	26404.500
729	25088.875	26338.875	767	25122.125	26372.125	805	25155.375	26405.375
730	25089.750	26339.750	768	25123.000	26373.000	806	25156.250	26406.250
731	25090.625	26340.625	769	25123.875	26373.875	807	25157.125	26407.125
732	25091.500	26341.500	770	25124.750	26374.750	808	25158.000	26408.000
733	25092.375	26342.375	771	25125.625	26375.625	809	25158.875	26408.875
734	25093.250	26343.250	772	25126.500	26376.500	810	25159.750	26409.750
735	25094.125	26344.125	773	25127.375	26377.375	811	25160.625	26410.625
736	25095.000	26345.000	774	25128.250	26378.250	812	25161.500	26411.500
737	25095.875	26345.875	775	25129.125	26379.125	813	25162.375	26412.375
738	25096.750	26346.750	776	25130.000	26380.000	814	25163.250	26413.250
739	25097.625	26347.625	777	25130.875	26380.875	815	25164.125	26414.125
740	25098.500	26348.500	778	25131.750	26381.750	816	25165.000	26415.000
741	25099.375	26349.375	779	25132.625	26382.625	817	25165.875	26415.875
742	25100.250	26350.250	780	25133.500	26383.500	818	25166.750	26416.750
743	25101.125	26351.125	781	25134.375	26384.375	819	25167.625	26417.625
744	25102.000	26352.000	782	25135.250	26385.250	820	25168.500	26418.500
745	25102.875	26352.875	783	25136.125	26386.125	821	25169.375	26419.375
746	25103.750	26353.750	784	25137.000	26387.000	822	25170.250	26420.250
747	25104.625	26354.625	785	25137.875	26387.875	823	25171.125	26421.125
748	25105.500	26355.500	786	25138.750	26388.750	824	25172.000	26422.000
749	25106.375	26356.375	787	25139.625	26389.625			

Table A-18: 26GHz CHINA C12 Frequency Band								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
840	25186.000	26436.000	878	25219.250	26469.250	916	25252.500	26502.500
841	25186.875	26436.875	879	25220.125	26470.125	917	25253.375	26503.375
842	25187.750	26437.750	880	25221.000	26471.000	918	25254.250	26504.250
843	25188.625	26438.625	881	25221.875	26471.875	919	25255.125	26505.125
844	25189.500	26439.500	882	25222.750	26472.750	920	25256.000	26506.000
845	25190.375	26440.375	883	25223.625	26473.625	921	25256.875	26506.875
846	25191.250	26441.250	884	25224.500	26474.500	922	25257.750	26507.750
847	25192.125	26442.125	885	25225.375	26475.375	923	25258.625	26508.625
848	25193.000	26443.000	886	25226.250	26476.250	924	25259.500	26509.500
849	25193.875	26443.875	887	25227.125	26477.125	925	25260.375	26510.375
850	25194.750	26444.750	888	25228.000	26478.000	926	25261.250	26511.250
851	25195.625	26445.625	889	25228.875	26478.875	927	25262.125	26512.125
852	25196.500	26446.500	890	25229.750	26479.750	928	25263.000	26513.000
853	25197.375	26447.375	891	25230.625	26480.625	929	25263.875	26513.875
854	25198.250	26448.250	892	25231.500	26481.500	930	25264.750	26514.750
855	25199.125	26449.125	893	25232.375	26482.375	931	25265.625	26515.625
856	25200.000	26450.000	894	25233.250	26483.250	932	25266.500	26516.500
857	25200.875	26450.875	895	25234.125	26484.125	933	25267.375	26517.375
858	25201.750	26451.750	896	25235.000	26485.000	934	25268.250	26518.250
859	25202.625	26452.625	897	25235.875	26485.875	935	25269.125	26519.125
860	25203.500	26453.500	898	25236.750	26486.750	936	25270.000	26520.000
861	25204.375	26454.375	899	25237.625	26487.625	937	25270.875	26520.875
862	25205.250	26455.250	900	25238.500	26488.500	938	25271.750	26521.750
863	25206.125	26456.125	901	25239.375	26489.375	939	25272.625	26522.625
864	25207.000	26457.000	902	25240.250	26490.250	940	25273.500	26523.500
865	25207.875	26457.875	903	25241.125	26491.125	941	25274.375	26524.375
866	25208.750	26458.750	904	25242.000	26492.000	942	25275.250	26525.250
867	25209.625	26459.625	905	25242.875	26492.875	943	25276.125	26526.125
868	25210.500	26460.500	906	25243.750	26493.750	944	25277.000	26527.000
869	25211.375	26461.375	907	25244.625	26494.625	945	25277.875	26527.875
870	25212.250	26462.250	908	25245.500	26495.500	946	25278.750	26528.750
871	25213.125	26463.125	909	25246.375	26496.375	947	25279.625	26529.625
872	25214.000	26464.000	910	25247.250	26497.250	948	25280.500	26530.500
873	25214.875	26464.875	911	25248.125	26498.125	949	25281.375	26531.375
874	25215.750	26465.750	912	25249.000	26499.000	950	25282.250	26532.250
875	25216.625	26466.625	913	25249.875	26499.875	951	25283.125	26533.125
876	25217.500	26467.500	914	25250.750	26500.750	952	25284.000	26534.000
877	25218.375	26468.375	915	25251.625	26501.625			

Table A-19: 26GHz CHINA C34 Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
968	25298.000	26548.000	1006	25331.250	26581.250	1044	25364.500	26614.500
969	25298.875	26548.875	1007	25332.125	26582.125	1045	25365.375	26615.375
970	25299.750	26549.750	1008	25333.000	26583.000	1046	25366.250	26616.250
971	25300.625	26550.625	1009	25333.875	26583.875	1047	25367.125	26617.125
972	25301.500	26551.500	1010	25334.750	26584.750	1048	25368.000	26618.000
973	25302.375	26552.375	1011	25335.625	26585.625	1049	25368.875	26618.875
974	25303.250	26553.250	1012	25336.500	26586.500	1050	25369.750	26619.750
975	25304.125	26554.125	1013	25337.375	26587.375	1051	25370.625	26620.625
976	25305.000	26555.000	1014	25338.250	26588.250	1052	25371.500	26621.500
977	25305.875	26555.875	1015	25339.125	26589.125	1053	25372.375	26622.375
978	25306.750	26556.750	1016	25340.000	26590.000	1054	25373.250	26623.250
979	25307.625	26557.625	1017	25340.875	26590.875	1055	25374.125	26624.125
980	25308.500	26558.500	1018	25341.750	26591.750	1056	25375.000	26625.000
981	25309.375	26559.375	1019	25342.625	26592.625	1057	25375.875	26625.875
982	25310.250	26560.250	1020	25343.500	26593.500	1058	25376.750	26626.750
983	25311.125	26561.125	1021	25344.375	26594.375	1059	25377.625	26627.625
984	25312.000	26562.000	1022	25345.250	26595.250	1060	25378.500	26628.500
985	25312.875	26562.875	1023	25346.125	26596.125	1061	25379.375	26629.375
986	25313.750	26563.750	1024	25347.000	26597.000	1062	25380.250	26630.250
987	25314.625	26564.625	1025	25347.875	26597.875	1063	25381.125	26631.125
988	25315.500	26565.500	1026	25348.750	26598.750	1064	25382.000	26632.000
989	25316.375	26566.375	1027	25349.625	26599.625	1065	25382.875	26632.875
990	25317.250	26567.250	1028	25350.500	26600.500	1066	25383.750	26633.750
991	25318.125	26568.125	1029	25351.375	26601.375	1067	25384.625	26634.625
992	25319.000	26569.000	1030	25352.250	26602.250	1068	25385.500	26635.500
993	25319.875	26569.875	1031	25353.125	26603.125	1069	25386.375	26636.375
994	25320.750	26570.750	1032	25354.000	26604.000	1070	25387.250	26637.250
995	25321.625	26571.625	1033	25354.875	26604.875	1071	25388.125	26638.125
996	25322.500	26572.500	1034	25355.750	26605.750	1072	25389.000	26639.000
997	25323.375	26573.375	1035	25356.625	26606.625	1073	25389.875	26639.875
998	25324.250	26574.250	1036	25357.500	26607.500	1074	25390.750	26640.750
999	25325.125	26575.125	1037	25358.375	26608.375	1075	25391.625	26641.625
1000	25326.000	26576.000	1038	25359.250	26609.250	1076	25392.500	26642.500
1001	25326.875	26576.875	1039	25360.125	26610.125	1077	25393.375	26643.375
1002	25327.750	26577.750	1040	25361.000	26611.000	1078	25394.250	26644.250
1003	25328.625	26578.625	1041	25361.875	26611.875	1079	25395.125	26645.125
1004	25329.500	26579.500	1042	25362.750	26612.750	1080	25396.000	26646.000
1005	25330.375	26580.375	1043	25363.625	26613.625			

Table A-20: 26GHz CHINA B3 Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
1096	25410.000	26660.000	1134	25443.250	26693.250	1172	25476.500	26726.500
1097	25410.875	26660.875	1135	25444.125	26694.125	1173	25477.375	26727.375
1098	25411.750	26661.750	1136	25445.000	26695.000	1174	25478.250	26728.250
1099	25412.625	26662.625	1137	25445.875	26695.875	1175	25479.125	26729.125
1100	25413.500	26663.500	1138	25446.750	26696.750	1176	25480.000	26730.000
1101	25414.375	26664.375	1139	25447.625	26697.625	1177	25480.875	26730.875
1102	25415.250	26665.250	1140	25448.500	26698.500	1178	25481.750	26731.750
1103	25416.125	26666.125	1141	25449.375	26699.375	1179	25482.625	26732.625
1104	25417.000	26667.000	1142	25450.250	26700.250	1180	25483.500	26733.500
1105	25417.875	26667.875	1143	25451.125	26701.125	1181	25484.375	26734.375
1106	25418.750	26668.750	1144	25452.000	26702.000	1182	25485.250	26735.250
1107	25419.625	26669.625	1145	25452.875	26702.875	1183	25486.125	26736.125
1108	25420.500	26670.500	1146	25453.750	26703.750	1184	25487.000	26737.000
1109	25421.375	26671.375	1147	25454.625	26704.625	1185	25487.875	26737.875
1110	25422.250	26672.250	1148	25455.500	26705.500	1186	25488.750	26738.750
1111	25423.125	26673.125	1149	25456.375	26706.375	1187	25489.625	26739.625
1112	25424.000	26674.000	1150	25457.250	26707.250	1188	25490.500	26740.500
1113	25424.875	26674.875	1151	25458.125	26708.125	1189	25491.375	26741.375
1114	25425.750	26675.750	1152	25459.000	26709.000	1190	25492.250	26742.250
1115	25426.625	26676.625	1153	25459.875	26709.875	1191	25493.125	26743.125
1116	25427.500	26677.500	1154	25460.750	26710.750	1192	25494.000	26744.000
1117	25428.375	26678.375	1155	25461.625	26711.625	1193	25494.875	26744.875
1118	25429.250	26679.250	1156	25462.500	26712.500	1194	25495.750	26745.750
1119	25430.125	26680.125	1157	25463.375	26713.375	1195	25496.625	26746.625
1120	25431.000	26681.000	1158	25464.250	26714.250	1196	25497.500	26747.500
1121	25431.875	26681.875	1159	25465.125	26715.125	1197	25498.375	26748.375
1122	25432.750	26682.750	1160	25466.000	26716.000	1198	25499.250	26749.250
1123	25433.625	26683.625	1161	25466.875	26716.875	1199	25500.125	26750.125
1124	25434.500	26684.500	1162	25467.750	26717.750	1200	25501.000	26751.000
1125	25435.375	26685.375	1163	25468.625	26718.625	1201	25501.875	26751.875
1126	25436.250	26686.250	1164	25469.500	26719.500	1202	25502.750	26752.750
1127	25437.125	26687.125	1165	25470.375	26720.375	1203	25503.625	26753.625
1128	25438.000	26688.000	1166	25471.250	26721.250	1204	25504.500	26754.500
1129	25438.875	26688.875	1167	25472.125	26722.125	1205	25505.375	26755.375
1130	25439.750	26689.750	1168	25473.000	26723.000	1206	25506.250	26756.250
1131	25440.625	26690.625	1169	25473.875	26723.875	1207	25507.125	26757.125
1132	25441.500	26691.500	1170	25474.750	26724.750	1208	25508.000	26758.000
1133	25442.375	26692.375	1171	25475.625	26725.625			

Table A-21: 28GHz ETSI C Frequency Band								
Index	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**	**Index**	**BS Tx TS Rx**	**BS Rx TS Tx**
520	28003.500	29011.500	602	28075.250	29083.250	684	28147.000	29155.000
522	28005.250	29013.250	604	28077.000	29085.000	686	28148.750	29156.750
524	28007.000	29015.000	606	28078.750	29086.750	688	28150.500	29158.500
526	28008.750	29016.750	608	28080.500	29088.500	690	28152.250	29160.250
528	28010.500	29018.500	610	28082.250	29090.250	692	28154.000	29162.000
530	28012.250	29020.250	612	28084.000	29092.000	694	28155.750	29163.750
532	28014.000	29022.000	614	28085.750	29093.750	696	28157.500	29165.500
534	28015.750	29023.750	616	28087.500	29095.500	698	28159.250	29167.250
536	28017.500	29025.500	618	28089.250	29097.250	700	28161.000	29169.000
538	28019.250	29027.250	620	28091.000	29099.000	702	28162.750	29170.750
540	28021.000	29029.000	622	28092.750	29100.750	704	28164.500	29172.500
542	28022.750	29030.750	624	28094.500	29102.500	706	28166.250	29174.250
544	28024.500	29032.500	626	28096.250	29104.250	708	28168.000	29176.000
546	28026.250	29034.250	628	28098.000	29106.000	710	28169.750	29177.750
548	28028.000	29036.000	630	28099.750	29107.750	712	28171.500	29179.500
550	28029.750	29037.750	632	28101.500	29109.500	714	28173.250	29181.250
552	28031.500	29039.500	634	28103.250	29111.250	716	28175.000	29183.000
554	28033.250	29041.250	636	28105.000	29113.000	718	28176.750	29184.750
556	28035.000	29043.000	638	28106.750	29114.750	720	28178.500	29186.500
558	28036.750	29044.750	640	28108.500	29116.500	722	28180.250	29188.250
560	28038.500	29046.500	642	28110.250	29118.250	724	28182.000	29190.000
562	28040.250	29048.250	644	28112.000	29120.000	726	28183.750	29191.750
564	28042.000	29050.000	646	28113.750	29121.750	728	28185.500	29193.500
566	28043.750	29051.750	648	28115.500	29123.500	730	28187.250	29195.250
568	28045.500	29053.500	650	28117.250	29125.250	732	28189.000	29197.000
570	28047.250	29055.250	652	28119.000	29127.000	734	28190.750	29198.750
572	28049.000	29057.000	654	28120.750	29128.750	736	28192.500	29200.500
574	28050.750	29058.750	656	28122.500	29130.500	738	28194.250	29202.250
576	28052.500	29060.500	658	28124.250	29132.250	740	28196.000	29204.000
578	28054.250	29062.250	660	28126.000	29134.000	742	28197.750	29205.750
580	28056.000	29064.000	662	28127.750	29135.750	744	28199.500	29207.500
582	28057.750	29065.750	664	28129.500	29137.500	746	28201.250	29209.250
584	28059.500	29067.500	666	28131.250	29139.250	748	28203.000	29211.000
586	28061.250	29069.250	668	28133.000	29141.000	750	28204.750	29212.750
588	28063.000	29071.000	670	28134.750	29142.750	752	28206.500	29214.500
590	28064.750	29072.750	672	28136.500	29144.500	754	28208.250	29216.250
592	28066.500	29074.500	674	28138.250	29146.250	756	28210.000	29218.000
594	28068.250	29076.250	676	28140.000	29148.000	758	28211.750	29219.750
596	28070.000	29078.000	678	28141.750	29149.750	760	28213.500	29221.500
598	28071.750	29079.750	680	28143.500	29151.500			
600	28073.500	29081.500	682	28145.250	29153.250			

Table A-22: 28GHz ETSI D Frequency Band								
Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
744	28199.500	29207.500	836	28280.000	29288.000	928	28360.500	29368.500
746	28201.250	29209.250	838	28281.750	29289.750	930	28362.250	29370.250
748	28203.000	29211.000	840	28283.500	29291.500	932	28364.000	29372.000
750	28204.750	29212.750	842	28285.250	29293.250	934	28365.750	29373.750
752	28206.500	29214.500	844	28287.000	29295.000	936	28367.500	29375.500
754	28208.250	29216.250	846	28288.750	29296.750	938	28369.250	29377.250
756	28210.000	29218.000	848	28290.500	29298.500	940	28371.000	29379.000
758	28211.750	29219.750	850	28292.250	29300.250	942	28372.750	29380.750
760	28213.500	29221.500	852	28294.000	29302.000	944	28374.500	29382.500
762	28215.250	29223.250	854	28295.750	29303.750	946	28376.250	29384.250
764	28217.000	29225.000	856	28297.500	29305.500	948	28378.000	29386.000
766	28218.750	29226.750	858	28299.250	29307.250	950	28379.750	29387.750
768	28220.500	29228.500	860	28301.000	29309.000	952	28381.500	29389.500
770	28222.250	29230.250	862	28302.750	29310.750	954	28383.250	29391.250
772	28224.000	29232.000	864	28304.500	29312.500	956	28385.000	29393.000
774	28225.750	29233.750	866	28306.250	29314.250	958	28386.750	29394.750
776	28227.500	29235.500	868	28308.000	29316.000	960	28388.500	29396.500
778	28229.250	29237.250	870	28309.750	29317.750	962	28390.250	29398.250
780	28231.000	29239.000	872	28311.500	29319.500	964	28392.000	29400.000
782	28232.750	29240.750	874	28313.250	29321.250	966	28393.750	29401.750
784	28234.500	29242.500	876	28315.000	29323.000	968	28395.500	29403.500
786	28236.250	29244.250	878	28316.750	29324.750	970	28397.250	29405.250
788	28238.000	29246.000	880	28318.500	29326.500	972	28399.000	29407.000
790	28239.750	29247.750	882	28320.250	29328.250	974	28400.750	29408.750
792	28241.500	29249.500	884	28322.000	29330.000	976	28402.500	29410.500
794	28243.250	29251.250	886	28323.750	29331.750	978	28404.250	29412.250
796	28245.000	29253.000	888	28325.500	29333.500	980	28406.000	29414.000
798	28246.750	29254.750	890	28327.250	29335.250	982	28407.750	29415.750
800	28248.500	29256.500	892	28329.000	29337.000	984	28409.500	29417.500
802	28250.250	29258.250	894	28330.750	29338.750	986	28411.250	29419.250
804	28252.000	29260.000	896	28332.500	29340.500	988	28413.000	29421.000
806	28253.750	29261.750	898	28334.250	29342.250	990	28414.750	29422.750
808	28255.500	29263.500	900	28336.000	29344.000	992	28416.500	29424.500
810	28257.250	29265.250	902	28337.750	29345.750	994	28418.250	29426.250
812	28259.000	29267.000	904	28339.500	29347.500	996	28420.000	29428.000
814	28260.750	29268.750	906	28341.250	29349.250	998	28421.750	29429.750
816	28262.500	29270.500	908	28343.000	29351.000	1000	28423.500	29431.500
818	28264.250	29272.250	910	28344.750	29352.750	1002	28425.250	29433.250
820	28266.000	29274.000	912	28346.500	29354.500	1004	28427.000	29435.000
822	28267.750	29275.750	914	28348.250	29356.250	1006	28428.750	29436.750

Table A-22: 28GHz ETSI D Frequency Band

Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx	Index	BS Tx TS Rx	BS Rx TS Tx
824	28269.500	29277.500	916	28350.000	29358.000	1008	28430.500	29438.500
826	28271.250	29279.250	918	28351.750	29359.750	1010	28432.250	29440.250
828	28273.000	29281.000	920	28353.500	29361.500	1012	28434.000	29442.000
830	28274.750	29282.750	922	28355.250	29363.250	1014	28435.750	29443.750
832	28276.500	29284.500	924	28357.000	29365.000	1016	28437.500	29445.500
834	28278.250	29286.250	926	28358.750	29366.750			